RAILWAY MECHANICAL ENGINEER

With which is incorporated the RAILWAY ELECTRICAL ENGINEER

(Names Registered, U. S. Patent Office)

Founded in 1832 as the American Rail-Road Journal

APRIL, 1948

Volume 122 *No. 4*

Roy V. Wright
Editor, New York

C. B. Peck
Managing Editor, New York

A. G. Oehler
Electrical Editor, New York

E. L. Woodward
Western Editor, Chicago

H. C. Wilcox
Associate Editor, New York

C. L. Combes
Associate Editor, New York

G. J. Weihofen
Associate Editor, Chicago

C. W. Merriken, Jr.
Business Manager, New York

●

Published monthly by

Simmons-Boardman Publishing Corporation

404 Wesley Ave., Mount Morris, Ill. Editorial and executive offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 530 W. Sixth street, Los Angeles 14, Calif.; 2909 Maple avenue, Dallas 4, Tex.

Samuel O. Dunn, *Chairman and President, Chicago;* James G. Lyne, *Executive Vice-President, New York;* Roy V. Wright, *Vice-Pres. and Sec., New York;* C. Miles Burpee, *Vice-Pres., New York;* F. C. Koch, *Vice-Pres., New York;* Robert E. Thayer, *Vice-Pres., New York;* H. E. McCandless, *Vice-Pres., New York;* S. Wayne Hickey, *Vice-Pres., Chicago;* H. H. Melville, *Vice-Pres. and District Sales Manager, Cleveland;* C. W. Merriken, *Vice-Pres., New York;* J. T. DeMott, *Treasurer, New York;* Ralph E. Westerman, *Asst. Treas., Chicago;* Arthur J. McGinnis, *Asst. Treas., New York.*

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. Printed in U. S. A.

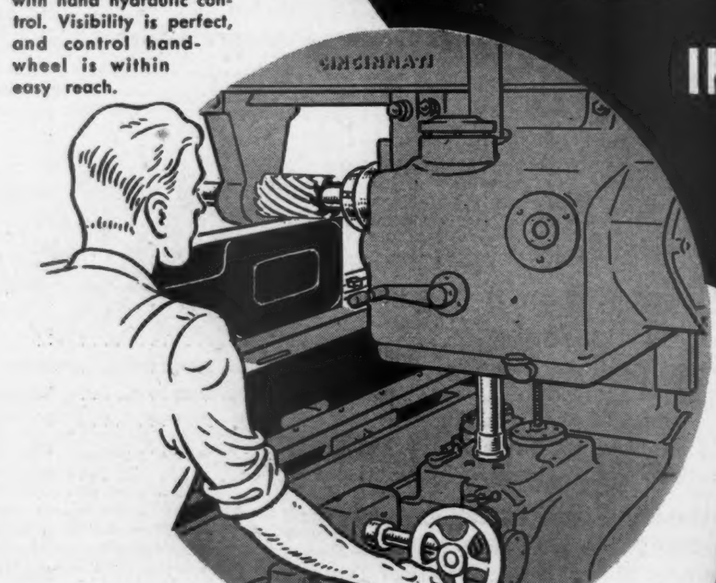
Subscriptions, payable in advance and postage free, United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Other countries in Western Hemisphere: 1 year, $5; 2 years, $8. All other countries: 1 year, $7; 2 years, $12. Single copies, 50 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

CINCINNATI

THIS EQUIPMENT SIMPLIFIES PROFILE AND CONTOUR MILLING OPERATIONS IN RAILROAD SHOPS

CINCINNATI Plain Hydromatic Miller. Also available in Duplex style. Catalog M-1372-1.

Below: Drawing shows position of operator at rear of a CINCINNATI Hydromatic Milling Machine with hand hydraulic control. Visibility is perfect, and control handwheel is within easy reach.



Right: This view, taken from the rear of the CINCINNATI Hydromatic, shows location of hand hydraulic control.

Take a CINCINNATI Hydromatic, equip it with hand hydraulic control, and you have a setup for profile and contour milling slide rods, main rods, and other large parts. Simply draw an outline of the part on the metal block, and, using the hand control, guide the cutters to follow the outline. The manually operated hand hydraulic control regulates the vertical movement of the spindle carrier during the table feed stroke. Perhaps some of the parts now being milled in your shop could be handled to better advantage on this type of equipment. Our engineers will be glad to discuss it with you. Complete data on CINCINNATI Hydromatics may be obtained by writing for catalog M-1372-1.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI 9, OHIO, U. S. A.

MILLING MACHINES • CUTTER SHARPENING MACHINES • BROACHING MACHINES

RAILWAY
MECHANICAL ENGINEER

Design and Construction of

Stayholted Fireboxes*

By F. P. Huston†

Minor changes in design and the use of new materials are suggested as the means to improve the firebox performance

THIS paper will discuss features of design, choice of materials, and methods of staybolt application. In dealing with the elements of design, material, and construction, it is hoped that new possibilities may be seen for the application of the staybolted firebox. It will be apparent that staybolt leakage is very much a part of the problem of design and the choice of materials. All recommendations and suggested changes are predicated upon the assumption that effective means will be taken to avoid staybolt leakage. These means will be discussed more fully in a later part of this paper.

Design Features

The use of two simple rules appears to be the guiding principle in our present-day designing practice. The first tells the designer what maximum spacing is permitted to be used for a given sheet thickness and working pressure. The second rule states that the maximum stress which can be applied to the staybolt due to boiler pressure is 7,500 lb. per sq. in. Both of these rules are taken from the work of the noted British engineer, William Cawthorne Unwin who was born in 1838 and died in 1933 at the age of 95.

Considering the fact that the formula from which the present code formula is derived was considered, years ago, to be unsatisfactory and that consideration has not been given to the proven ability of the present-day firebox sheet material, particularly the alloy steels, to safely withstand stresses considerably greater than 7,100 lb. per sq. in. under comparable conditions of service, it would seem useful to initiate a research program to establish stress allowances more in keeping with modern design practice and materials. The 7,500 lb. per sq. in. stress limitation on staybolts is even more restrictive than the limitations placed on the sheets. As in the case of firebox sheets, this stress limitation on staybolts is apparently taken from Unwin, who limits the working stress to a maximum of 5,000 lb. per sq. in. for copper stays, 7,500 for iron and 9,000 for steel.

Actually, the 7,500 lb. per sq. in. limitation requires the use of staybolts of such size as to impose higher stress on the structure, particularly on the fire sheet and staybolt fastening than would be obtained with smaller diameter staybolts stressed to some higher value. This is true because stresses due to bending are superimposed on the static tensile stress due to boiler pressure. For example, suppose that one-inch diameter straight body staybolts spaced on 4-in. by 4-in. centers are stressed to 7,000 lb. per sq. in., which is obtained at 271 lb. per sq. in. boiler pressure, were replaced with ⅞-in. straight body staybolts, then the direct tensile stress is increased to about 9,260 lb. per sq. in. However, for a given degree of bending due to displacement of the fire sheet in respect to the wrapper sheet from temperature differences, the total stress, which is the direct tensile stress plus the tensile bending stress, is actually lower. It is the total stress that causes staybolts to leak, resulting in cracked sheets, or to break.

Specifically, for a total displacement of 0.020 in. between sheets spaced 8 in. apart, the bending stress on the one-inch staybolt is calculated to be 24,400 lb. per sq. in. and on the ⅞-in staybolt, 20,900 lb. per sq. in., making the total stress in tension 31,400 lb. per sq. in. and 30,600 lb. per sq. in. respectively. The resistance to bending which is translated into tensile and buckling stresses in the thinner firebox sheet, is reduced from about 870 lb. per stay for the one-in. diameter staybolt to about 460 lb. for the ⅞-in., or a reduction of 46 per cent.

The high costs incurred through the use of oversize staybolts is well demonstrated in tests which showed a decrease of 39 per cent in the average mileage life of side sheets when 1$\frac{1}{16}$-in. diameter stays follow an application of 1-in. diameter. In addition, about 14 per cent more dead weight is added to the weight of staybolts on the trailing trucks with a comparable increase in the cost of material. The use of 1⅛-in. diameter stays which average one-third less mileage life with nearly one-third more dead weight and nearly one-third more material costs over one-inch diameter, is equally striking. It is significant that ⅞-in. diameter straight body staybolts meet the 7,500 lb. per sq. in. limit for 20 lb. per sq. in. boiler pressure with a 4-in. spacing and could be expected to effect an appreciable increase in side sheet life over the one-inch diameter stays with lower weights and material costs.

The advantage of smaller diameter staybolts with correspondingly closer spacing as compared with current staybolting practices is indicated in Fig. 1, which shows the stress-deflection relations of three assemblies tested at the Massachusetts Institute of Technology. These

*Abstract of paper presented before the Railroad and Metals Engineering divisions, American Society of Mechanical Engineers, on December 2, 1947, at the annual meeting of the society at Atlantic City, N.J.

†Deceased. Mr. Huston was formerly in charge of railroad development, Development and Research, International Nickel Company, New York.

are the stresses in the plate at an average distance of about 3/32 in. from the edge of the hole. The concentrated stress at the edge of the hole where cracking starts may be two or more times these measured stresses. The measured stresses of 19,300 lbs. per sq. in. and 21,300 lbs. per sq. in. at 0.40-in. deflection for the assemblies stayed with one-inch iron staybolts maye be increased to stresses of the order of 38,000 to 42,000 or higher as concentrated stresses at the edge of the hole. These are reduced to less than half by the change to the smaller staybolt in assembly No. 3.

It is obvious from these tests and from observations in service that, since locomotive fireboxes continue to

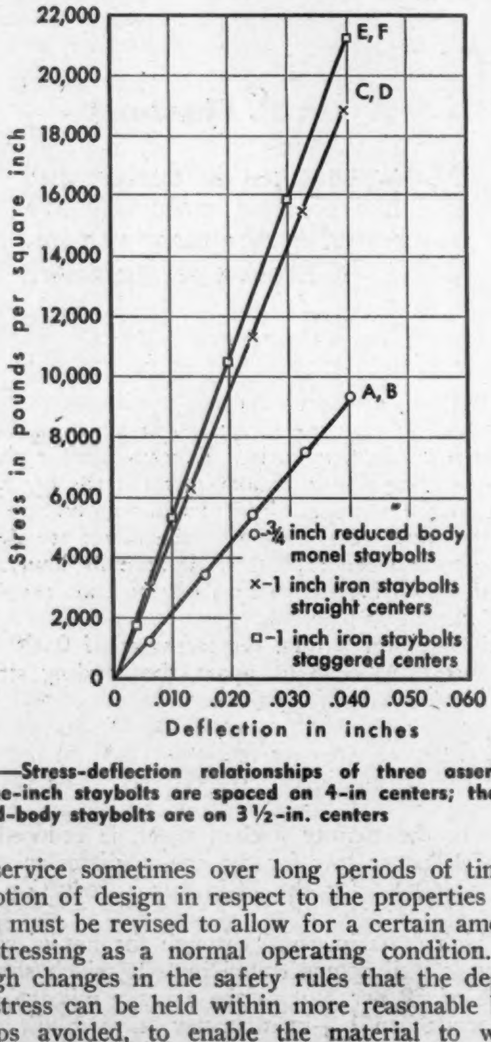


Fig. 1—Stress-deflection relationships of three assemblies—The one-inch staybolts are spaced on 4-in centers; the ¾-in. reduced-body staybolts are on 3½-in. centers

give service sometimes over long periods of time, our conception of design in respect to the properties of materials must be revised to allow for a certain amount of over-stressing as a normal operating condition. It is through changes in the safety rules that the degree of over-stress can be held within more reasonable bounds, perhaps avoided, to enable the material to work at stress levels below the proportional limit.

The type of staybolt is definitely an element of design becoming increasingly more important as the length of the staybolt decreases in the narrow water spaces. The choice lies between the straight-body type for the narrow water space and the reduced-body type. The longer stays, of about 10 in. length and longer, have, for obvious reasons, the reduced-body section, usualy made by upsetting the ends. The reduced-body staybolts offer advantages over the straight-body type, particularly in the shorter lengths as used in the narrow water spaces. These include: (1)—Improved stress distribution between the staybolt, the sheets and the fastenings; (2)—Greater freedom in design to control distortion and stress relations between adjacent areas of the structure; (3)—Reduced dead weight; (4)—Economy of material, and (5)—Two or three times more bolts can be threaded and run in per hour.

Now that staybolt leakage is recognized as the prime cause of firebox sheet failures, a new concept of the properties of sheet materials provides a more reliable guide in selecting sheet materials for long service life than was had heretofore.

A great deal of effort has been expanded to develop a firebox steel that will resist failures due principally to cracking. Much of the early work was done by the Germans in following the hypothesis that ageing characteristics exerted an important influence on cracking, and as a result the heavily aluminum deoxidized steel known as "Izett" was placed on the market, which, in laboratory tests, was shown to be virtually non-ageing. Much work was done with the nickel steels, and it was proven that nickel strongly inhibits ageing effects. However, in spite of the rather large amount of study that has been directed to steels of special composition and manufacture, no significant progress was made in eliminating the cracking of firebox sheets because in these studies the influence of leakage was considered to be unimportant.

Comparative tests of three different steels were made on an eastern railroad in three classes of locomotives involving a total of 17 locomotives. One of these steels was the railroad's specification deoxidized carbon steel which has been standard for a number of years. The other two steels were steels offered by producers as having properties better suited to firebox service than carbon steel. Each locomotive in the test was fitted on one side with one kind of steel and on the opposite side with another kind. In all but two instances, failures occurred in both steels at the same mileage in each locomotive. There is no significance to be attached to the deviation in the two non-conforming cases.

A second eastern railroad duplicated this test, applying their standard specification deoxidated carbon steel on one side in camparative tests with three low alloy fiebox steels. At this writing (Aug. 1947), five pairs of sheets have failed, including failures of all three special steels. The average mileage life obtained was 88,000 with a maximum of 107,000 and a minimum of 70,000 miles. Each sheet of the pair failed at the same mileage and location, involving practically the same number of staybolts.

The first railroad has in progress a second series of performance tests. Several pairs of sheets have failed in this second series, also at the same mileage. It seems that the consistency of the results of these controlled series of tests, coupled with scattered data gathered from locomotives on these and other railroads, should prove beyond reasonable doubt that the service life of firebox sheets bears no significant relation to composition, method of manufacture or physical characteristics of the ferritic steels.

Alloyed steels, regardless of the alloys used, or carbon steels of special manufacture, regardless of method, cannot be expected to show any advantages one over the other under the conditions applying. It is significant here to note that the conditions which applied in these tests and in the scattered service data referred to included the use of staybolts applied in the conventional manner of screwing through with ends riveted over. It seemed apparent from early failures in the series of tests, since composition and properties have no appreciable effect on service life, that staybolt leakage resulting in intercrystalline embrittlement is the basic cause of the cracking of firebox sheets.

Staybolt Leakage

On this assumption a series of tests was started to determine to what extent staybolt leakage was the cause of

cracking of firebox sheets. The first locomotive in this series of tests was placed in service in June, 1942. The results of these tests, together with those from other railroads, have well proven that staybolt leakage is the immediate cause of the cracking of sheets.

With this knowledge, a different criterion is provided to select materials best suited to locomotive firebox use. Service data show that for most classes of power the standard deoxidized carbon steel in current use will give satisfactory mileage if staybolt leakage is avoided. With heavy duty power, however, low alloy, high strength steels should prove economical in providing many years of maintenance-free firebox service because of their ability ot withstand the more severe conditions imposed on the firebox sheets as the result of higher firing rates, greater temperature fluctuations and the like.

The use of nickel as an alloy is particularly beneficial in conferring optimum combination of properties—high strength with improved ductility and toughness at low carbon levels. This nickel steel is covered by Grades "A" and "B" of A.S.T.M. Specification No. A-203. For particularly severe conditions, which may be encountered in special cases where boiler water scale may cause the overheating of firebox sheets the use of nickel-clad steel, applied with the nickel on the water side to prevent scale adherence, is indicated.

Staybolts

It has been shown* that staybolts in locomotive boilers are normally subjected to stresses exceeding the yield point of the material. A study of the division of a firebox into "breaking" and "non-breaking" zones indicates clearly the existence of a "threshold" level of stresses marking a rather sharp demarcation between locations where breakage frequently occurs and locations where

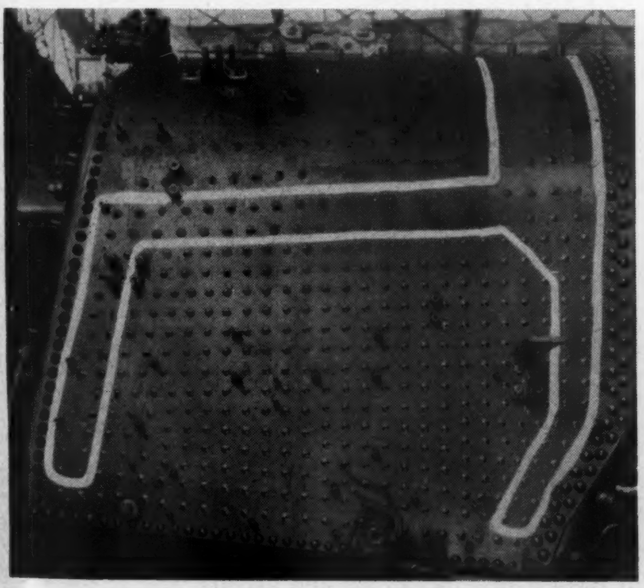


Fig. 2—All rigid-type staying in Pacific type locomotive side sheets and expansion zone stayed with Monel "rigids" as outlined in chalk

breakage seldom occurs. It becomes evident at the division line of the two zones that the stresses imposed on a simple type staybolt are just under the threshold and that in the next row, just four inches away, the stresses are just over the threshold. On this continent the almost exclusive use in the breaking zones of flexible iron or steel staybolts, which are fitted at the outside end with

Fig. 3—Monel "rigids" in throat sheet outlined in chalk

a ball and socket joint, is generally effective in avoiding breakage. This is because the bending stresses are thusly reduced to below the "threshold" values. However, the method is costly and imposes severe limitation on advancements in design and performance of the staybolted firebox.

With the aim of retaining the simple rigid-type staybolt throughout the entire boiler, a change in the nature of the material used in the breaking zones must be made from wrought iron or low-carbon steel to material capable of withstanding the breaking stresses. This problem received first attention abroad over 50 years ago with the advent of the use of copper staybolts. With the need for obtaining materials of higher strength and better corrosion resistance, applications were made as early as 1910 of the nickel-copper alloy "Monel." Applications of rigid type Monel staybolts throughout the breaking zones in 4-6-2 locomotives on a Canadian railroad are shown in Figs. 2, 3 and 4. A total of twelve locomotives of this

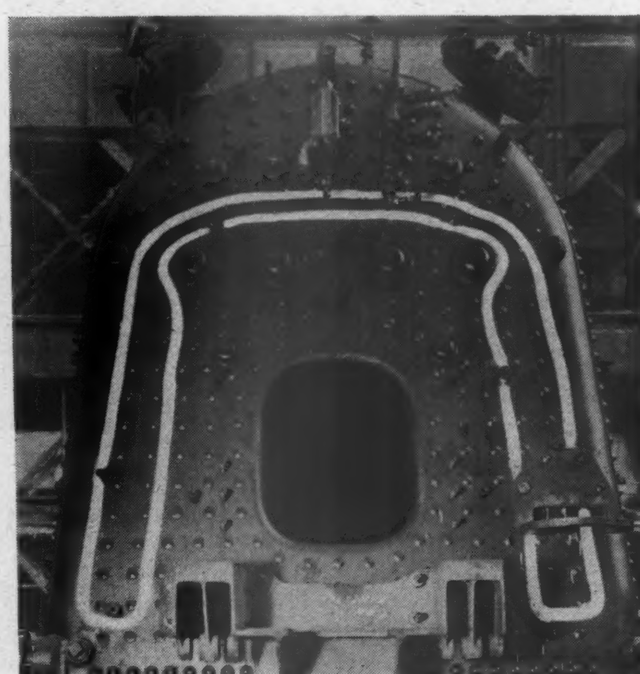


Fig. 4—Monel "rigids" in back head outlined in chalk

*"A Study of Firebox Materials and Design," pages 519-524, November, 1943, issue, Railway Mechanical Engineer.

construction are in service, two since the middle of 1944 and ten which were built last year. Ample experience and service data are available from the large number of locomotives abroad stayed throughout the breaking zones with Monel and from a sufficiently large number on this continent to supplement these data.

In the non-breaking zones, where the stresses are below the threshold value for wrought iron and steel, rigid type staybolts may be used with little danger of breakage. Wrought iron is used in fully 80 per cent of the locomotives in this country. Nickel-steel staybolts are used in practically all of the remaining 20 per cent and are standard throughout Canada.

The compartively recent development of seal welding, and its rapidly increasing use, has given impetus to the adoption of low-carbon alloy steels in place of wrought iron for staybolts. Nickel staybolt steels, containing up to about 2.25 per cent nickel, have been in successful use on this continent and abroad for many years. Other low alloy steels are currently being tested for this service.

Staybolt Leakage

That leakage of staybolts is the immediate and prime cause of the cracking of firebox sheets is proven beyond reasonable doubt from service records dating back to June, 1942.

Data based on mileage records are reliable in establishing the fact that staybolt leakage is the important cause of cracked sheets and that by avoiding leakage the cracking of side sheets is apparently cured. The results are even more striking where leak-tight application is made in one side and the conventional, or leaky, method is used in the opposite side of the same locomotive. A number of such tests have been in progress for the past several years. A good example is shown in Fig. 5, where the evidence of leakage in the riveted-over side is un-

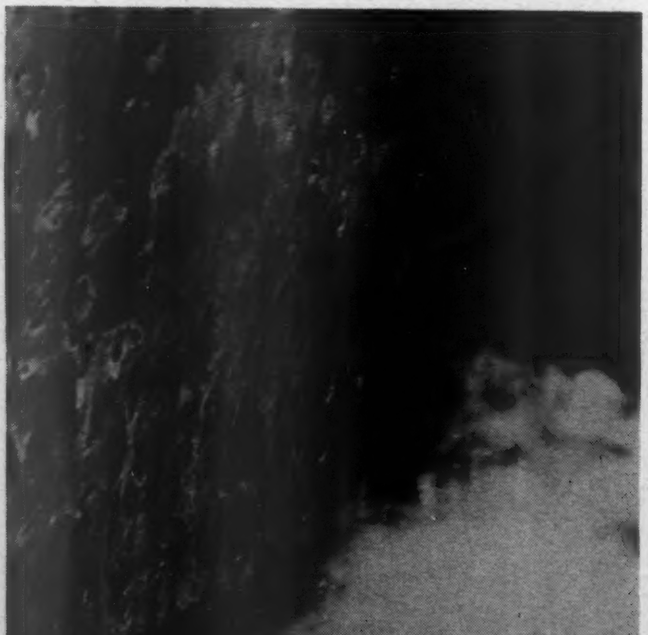


Fig. 5—Leaky riveted-over staybolts in left side of firebox in test of riveted-over vs. seal welding

mistakable. This type of application was made in two Hudson-type locomotives which were placed in service in June and July, 1945. The leaky sheets of both required extensive patching in July of this year (1947). The seal welded sides do not show any ill effects.

Today, seal welding has been applied in about 300 locomotives in this country and Canada. Several roads have established seal welding as standard practice, and the problem of cracked firebox sheets, which has been so costly in the past, can now be considered satisfactorily solved in view of the performance records. Leak-tight construction has done more than reduce the cost of firebox maintenance—it has opened the way for advances in the design and construction of the staybolted

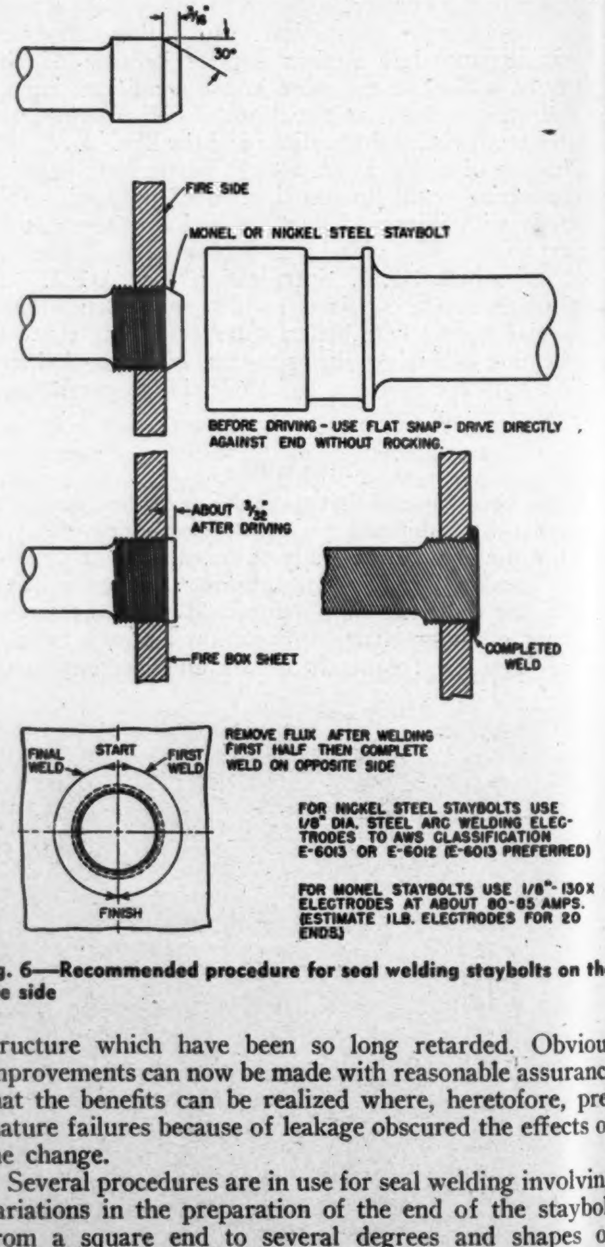


Fig. 6—Recommended procedure for seal welding staybolts on the fire side

structure which have been so long retarded. Obvious improvements can now be made with reasonable assurance that the benefits can be realized where, heretofore, premature failures because of leakage obscured the effects of the change.

Several procedures are in use for seal welding involving variations in the preparation of the end of the staybolt from a square end to several degrees and shapes of chamfers, in the length extending beyond the fire sheet, in holding on, hucking-up and driving, and in the position of the start and directions for welding. These differences are probably of little consequence in obtaining a welded steel against leakage. They may, however, be of considerable importance in respect to the possibility of failures from cracked welds with threads that are too loose or too weak to prevent over-stressing the root of the weld when severe displacement of the fire sheet occurs.

Many degrees of thread fit, from very loose to tight, result from the wide variations among roads in tap and staybolt pitch diameter tolerances, and in tapping practices. In making early test installations of seal welding on several roads in this country about five years ago, the relatively loose thread fits encountered made it neces-

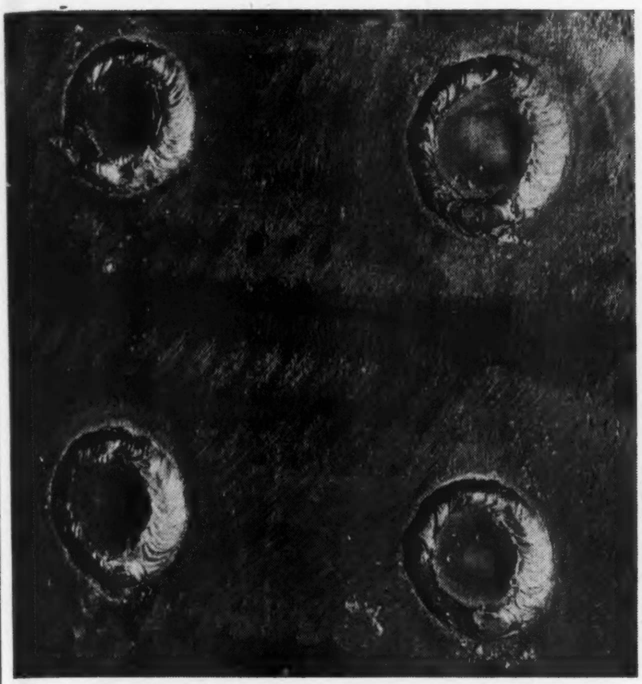


Fig. 7—Seal welded staybolts

sary to hammer the staybolt on the fire side before welding. The recommended procedure shown in Fig. 6 was developed from the experience gained on these roads, and Fig. 7 shows the finished seal welded ends.

Shortly after the early work was done in this country, a Canadian road applied seal welding in one side sheet in each of two locomotives for comparison with conventional riveted-over construction in the opposite sides. It was found that the practice on this road gave thread fits sufficiently tight to make hammering or driving on the fire side unnecessary. The staybolt is "bucked-up" with a dolly on the fire side for hammering and riveting-over the outside end, and then seal welding is applied without further hammering. The soundness of this procedure is evidenced by the complete freedom from leakage in the seal welded sides in these two locomotives, as well as in more than fifty locomotives placed in service after this seal welding procedure had been adopted as the standard.

As an approach to eliminating hammering on the fire side, one of the leading staybolt tap manufacturers is producing a standard tap well suited to obtaining the degree of tightness required. The length of threads on the tap is sufficient to maintain continuity of lead for water spaces of 11 in. and under. The thread is commercially ground to basic pitch diameters plus and minus 0.0005 in. With these taps, good fits have been obtained in several recent applications with staybolts threaded 0.002 in. over basic pitch diameter. The proper size for the degree of fit required must be determined by trial until such a time as suitable accurate standards are developed. For fits sufficiently tight to make hammering unnecessary, a degree of fit approaching the Class 5 interfering fit is required.

Stripping of the threads is avoided through the use of graphite in the oil used for tapping or applied to the staybolt for running in. Collodial graphite is highly efficient and used in the proportion of 2 oz. of a 20 per cent suspension to form a quart to a gallon of oil. Suitable oils for tapping include red engine oil, castor oil and water soluble oil. The use of graphite on the threads of all staybolts is advisable against stripping, particularly where thread lead is not maintained.

Explosively-Set Staybolts

Early in the studies leading to a workable solution of firebox failures, it was realized that to obtain the maximum efficiency against leakage in the screwed staybolt fastening a means was required to effectively expand the staybolt into the sheet to obtain a strong metal-to-metal fitting over all engaging threads. The Henschel method of expanding by drifting had been in use over twenty-five years abroad for both steel and Monel staybolts with good success but only a passing interest was shown here in the method because of its higher cost and the need for staybolts and tools of special design.

The idea of effecting the expansion with an explosive was presented to the research staff of the du Pont organization, who started experimental work early in the summer of 1941. Initial trials led to the successful application of Monel and nickel-steel staybolts on two Canadian roads.

Electric firing was used in the installations now in service, but this method has been superseded by a "gun" recently developed by Canadian Industries Limited, which makes it possible to use a cheaper type of blasting cap, eliminates the time-consuming preparation of electrical connections formerly required and greatly reduces the noise from the explosion. With the "gun," caps of the type normally ignited by means of a fuse are fired by directing the flame from the primer of a .22 calibre cartridge into the end of the cap.

The explosive method virtually eliminates the human equation. With the old method there was no way of determing the condition of the threads after hammering. With the explosive method, the degree of expansion is determined by simply gauging the size of the hole. After firing, the stybolt end may be finished by rolling-over the edge with a smooth bobbing tool. An alternate method, which incorporates the best of our present knowledge in fitting screwed staybolts, consists of seal welding followed by expanding with the explosive cap.

Fusion-Welded Staybolts

Eventually, the screwed staybolt will be relegated to the past and the fusion welded fastening substituted.

(*Continued on page* 80)

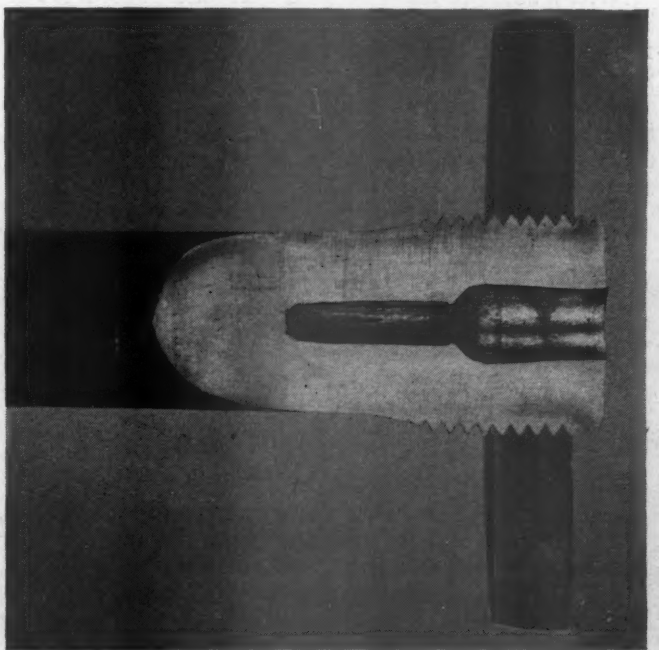


Fig. 8—Section of staybolt expanded with explosive cap

F.E.C. Diesel Instruction Car

THE Florida East Coast Railway has just completed a new instruction car, which incorporates many improvements over an older car used for many years in educating its transportation and mechanical employees in locomotive and air-brake operation and maintenance.

After a study of many such cars on other railroads, the layout was designed and built by the company's own forces at its St. Augustine, Fla., shops. One of the improved features of the car is a more complete exposure of all working parts, units and electrical circuits, particularly those involved in Diesel locomotive operation. The car, of all-steel construction, was converted from a passenger coach with an inside length of 70 ft.

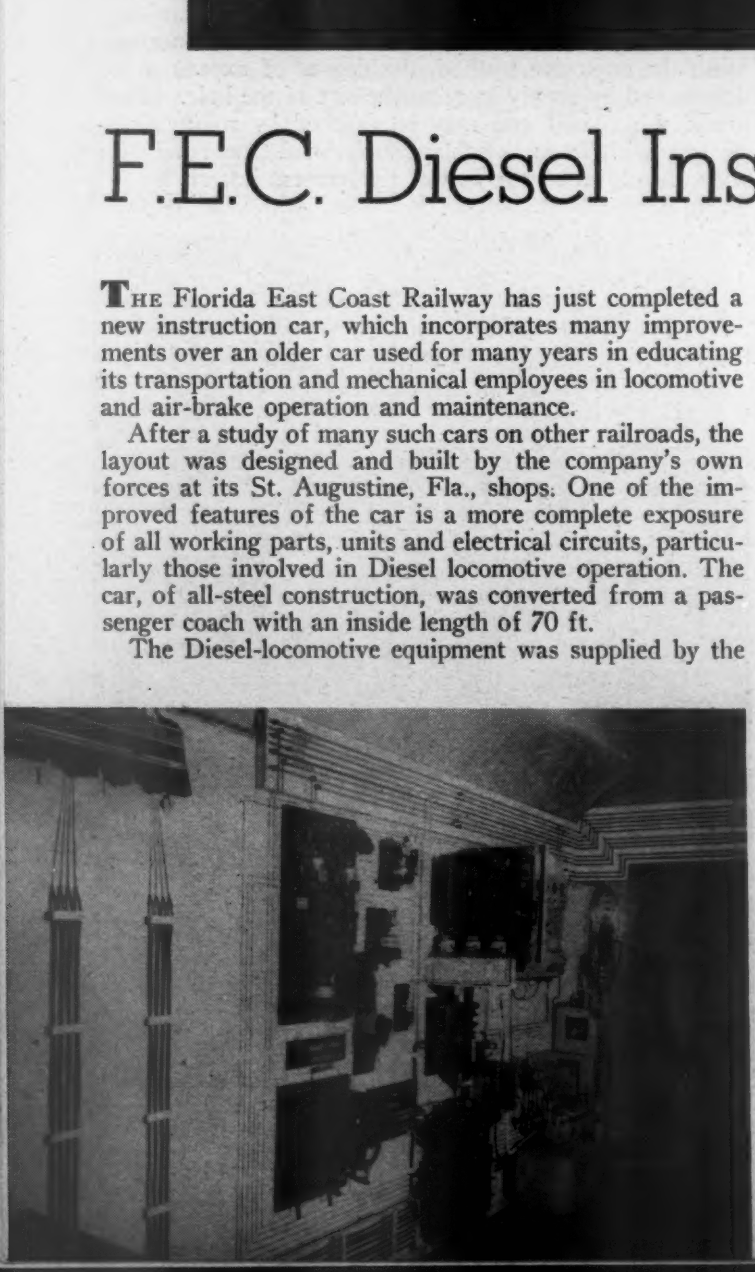
The Diesel-locomotive equipment was supplied by the Electro-Motive Division of General Motors. It consists of a complete Diesel engineman's control stand, mounted on a raised platform, a mock-up of two cylinders of a Diesel engine with governor, governor control, injector linkage and cut-away cylinder head. A lever-operated injector is used to demonstrate the injection of fuel into the cylinder.

Also included is a load regulator, a complete set of No. 1 engine-control equipment, and a mock-up of the main generator with field coils traced in colors. Small lights indicate the presence and intensity of the field excitation as controlled by the load regulator. The wheels of a model Diesel locomotive mounted on the wall operate both forward and reverse in complete response to the manual and automatic control units.

The control units of a Diesel were removed from their cabinets and mounted on a plywood wall in their relative positions, but spaced sufficiently to permit individual wiring. Where possible, these wires are run in straight lines on the wall and are painted in different colors to form a live working diagram of the complicated high- and low-voltage circuits.

The nine important control circuits are wired in different colors from the distribution panel, control switch box and control stand. Each circuit is traced in identifying colors with small lights to indicate when the circuit is energized. There is also a panel above the control circuits, in plain view of the entire class room, to indicate the position of the throttle and reverse lever.

A mock-up of a Vapor Clarkson CFK4225 steam generator, with coils and heat exchanger cut-away, operates through various safety devices.



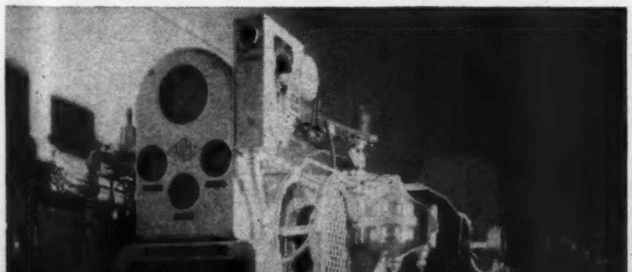
Model of Diesel locomotive (upper left) and live diagram of control circuits and units are improved features of the new instruction car

The brake equipment consists of a complete set of HSC car brakes electrically connected to a large diagramatic drawing of two HSC car brakes with small lights to illustrate the electric brake and speed-governor-control circuits. The balance of the equipment in the car is more or less standard as regards air-brake and steam-locomotive operation.

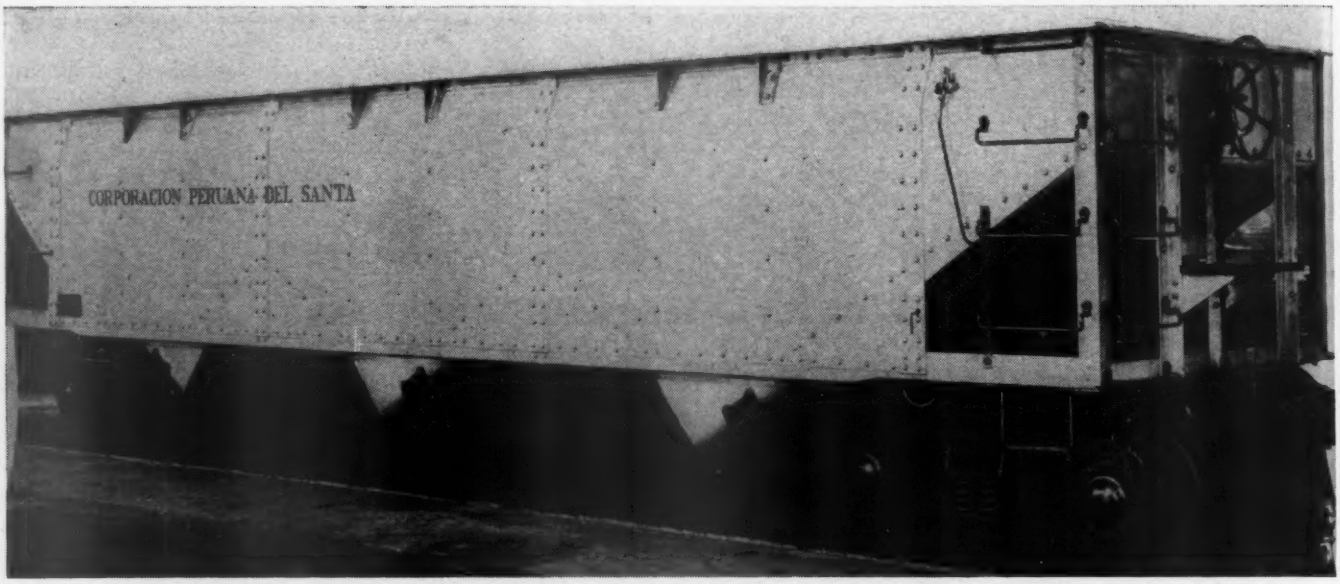
A 16 mm. motion-picture projector, with sound effect, has been installed to show pictures in connection with Disels and roller bearings, and other educational films.

Officers of the Florida East Coast who were responsible for designing and building the instruction car (left to right): H. L. Hodges, mechanical engineer; J. D. Mays, shop superintendent; R. B. Hunt, chief mechanical officer, and Gordie Stewart, superintendent of air brakes

Power for the car is derived from a motor-generator located on the rear platform which provides 64-volt d.c. current, and a motor-driven compressor. Both motors operate on 220-volt three-phase a.c. current. Two 20-in. fans, mounted in side windows, cool the car in summer. ing is used throughout.
It is warmed in winter by an oil-heater. Flourescent light-



Above: The mock-up of a Diesel steam generator unit—Right: The Diesel locomotive engineman's control stand and HSC brake equipment at the forward end of the car



Hopper car with aluminum body built by the Mt. Vernon Car Manufacturing Division, Pressed Steel Car Company, Inc.—Load limit, 103,000 lb., light weight 23,400 lb.

Aluminum

Freight-Car Construction*

By R. B. Borucki and E. A. Sipp†

A discussion of weight saved in several car designs, including 50-ton box cars and 50-ton and 70-ton hopper cars

Weight reduction in freight cars can be made either by the use of present ferrous materials and sound, thorough engineering analysis, or by the adoption of lightweight non-ferrous materials, such as aluminum alloys or magnesium alloys. Limitations exist with the use of ferrous materials, such as weight-stress ratios, deflections, and safety factors. The material basis of all weight-reduction comparisons employed usually is open-hearth carbon steel, cast iron, and cast steel. The first attempt to reduce weight in freight cars was by the use of the high-tensile low-alloy steels and aluminum alloys.

The first all-aluminum freight cars—hopper cars—were built in 1931 by the Canton Car Company and were placed in service in the aluminum industry in the middle west. These cars were reported in the April, 1932, issue of *Railway Mechanical Engineer* as weighing 38,900 lb. at the rail. A weight reduction of 21,200 lb. was claimed and credited to the use of 12,500 lb. of aluminum in the car. This was a 70-ton car having a capacity of 2,475 cu. ft. as compared to the present standard A.A.R. 70-ton steel hopper car which has a capacity of 2,773, cu. ft. and weighs approximately 54,000 lb.

These cars are now 16 years old, and the last inspection made by a representative of Reynolds Metals Company (February 29, 1944) showed no evidence of wear or tear from service. However, there was some evidence of electrolytic corrosion between dissimilar aluminum alloys, principally due to the use of steel rivets.

In 1934, the Baltimore & Ohio built one 50-ton aluminum hopper car weighing 27,200 lb. on the rail and used 10,711 lb. of aluminum alloys. The car had a capacity of 2,450 cu. ft., and a weight saving of 16,185 lb. was claimed as compared to the A.A.R. 50-ton steel hopper car which weighed approximately 43,000 lb. and had a capacity of 2,145 cu. ft. The additional 305 cu. ft. permitted an increased loading in the aluminum car of approximately eight tons per trip.

Aluminum Box Cars

No major projects of freight-car construction were undertaken after the Canton and B. & O. cars were built until Reynolds Metals Company, Railway Division, introduced 30 aluminum box cars in 1944-1945 with the cooperation of the Mt. Vernon Car Manufacturing Division of Pressed Steel Car Company and the Chicago, Rock Island & Pacific, the Alton, and the Minneapolis & St. Louis. These cars, engineered by Reynolds and made to a design approved by the A.A.R. Car Construction Committee, were not designed for maximum weight reduction, but were rather of rugged build to determine

*Abstract of a paper sponsored by the Railroad Division which was presented on December 4, 1947, at the annual meeting of the American Society of Mechanical Engineers at Atlantic City, N. J.

†Mr. Borucki is chief engineer, and Mr. Sipp, manager, Reynolds Metals Company, Railway Division, Chicago.

Table I—Comparative Weights of Aluminum Box-Car Parts

	Weights, lb. M. & St. L.	Alton	C., R. I. & P.
Trucks	13,000	13,760	18,560
Steel underframe	10,200	10,600	10,600
Roof, aluminum	833	833	833
Ends, aluminum	1,028	1,028	1,028
Doors, aluminum and steel	738	652	738
Running boards and brake step	186	186	186
Aluminum sides	3,996	3,995	3,998
Lumber, insulation, and paint	6,570	6,500	6,500
Safety appliances	377	377	377
Hand brakes	72	69	80
Weight of car body	24,000	24,240	24,340
Total weight on rail	37,000	38,000	42,900

WEIGHT ANALYSIS BY MATERIALS

	Lb.	Per cent
Weight of aluminum in underframe	520	.....
Weight of aluminum in superstructure	6,495	.....
Total aluminum in car	7,015	29.2
Total steel in car	10,415	43.4
Total lumber, paint, etc., in car	6,570	27.4
Total weight of car body	24,000	100.0

how they would stand up in freight service. Table I shows the weights of the cars divided into the component parts of the car.

The weight saving in these cars is based on comparative weights of car bodies, since trucks were of special designs and could also be used for steel cars.

The aluminum car-body weight was 24,000 lb. compared to the A.A.R. standard car of similar size (45,000-15,600) which weighed 29,400. There was therefore an actual weight saving of 5,400 lb. effected by the use of aluminum in the car body.

These cars were thoroughly inspected during 1947, and from their condition it was concluded that future box cars could be made lighter by using lighter sections in the superstructure; accordingly such a car was designed by Reynolds. Table II shows the weight reduction in the Reynolds A.A.R. approved design.

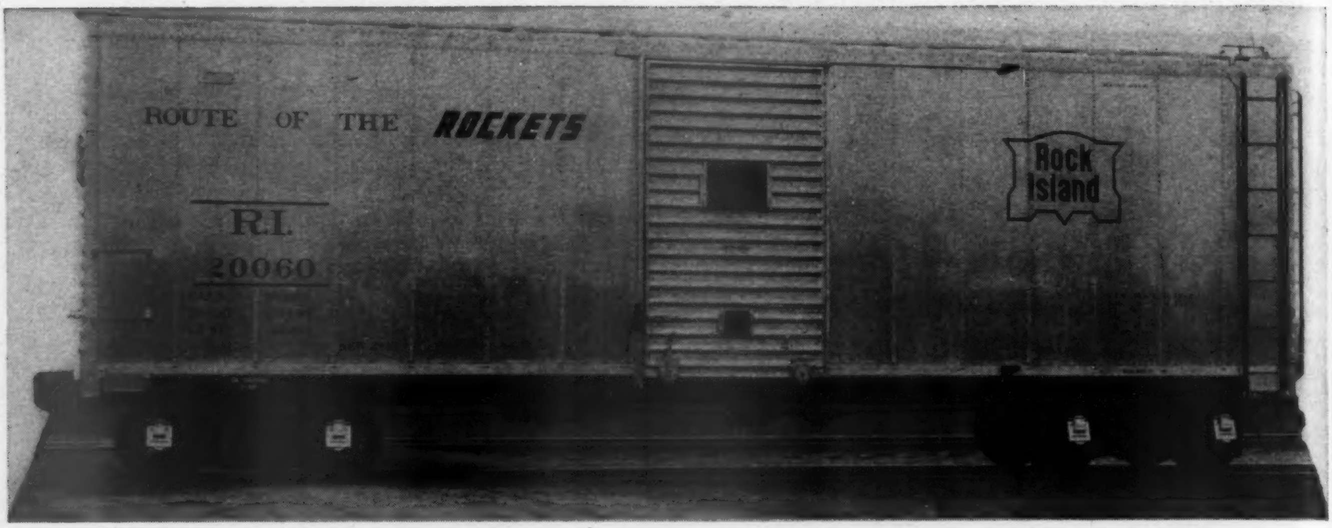
The weight reduction in the Reynolds new design is 7,880 lb., or approximately four tons. This, we believe, is the best weight reduction that can be made today; however, further reduction could be made if the ends could be economically manufactured of aluminum. It is to be noted that we have shown steel ends in our weight analysis. The reason for this is that it is uneconomical to manufacture aluminum ends with the present available tools and dies. We have experimentally pressed single corrugations in a cold-tempered, high-strength, aluminum alloy and have determined the necessary tonnage required for such operation. We have also determined the exact die equipment necessary for this operation. The results of our experiment indicated both increased press capacity and new dies of such initial cost that, until such time as box cars are

Table II—Weight Comparison of 50-Ton Box Cars with Standard Inside Dimensions

	Car-body parts, lb. A. A. R. Plate 1500 standard car	Reynolds aluminum car, Drawing C-400
Underframe	7,260	5,497
Sides	5,800	2,696
Ends	2,430	1,975*
Roof	1,830	700
Running board	370	233
Doors	1,620	637
Coupling equipment	3,350	2,820
Body brakes	1,350†	1,350‡
Safety appliances	410	295
Hand brake	100	80
Miscellaneous rivets, bolts, etc.	1,360	460
Wood lining and floor	4,980	4,980
Weight of car body	30,860	21,723
Weight of trucks	15,600	15,600
Total weight on rail	46,460	37,323
Load limit	122,540	131,677
Load limit on rail	169,000	169,000
Total weight of aluminum in car		4,966
Direct weight saving by use of aluminum only (not taking into account the weight saving in coupling equipment, ends, and steel parts in doors)		7,880
Actual on-rail weight difference (46,460 — 37,323):		9,137

*High-tensile low-alloy steel Dreadnaught ends.
†AB.
‡ABEL.

Experimental aluminum-alloy refrigerator car weighing approximately five tons less than similar steel cars built by F.G.E.



A 50-ton aluminum-alloy box car equipped for head-end passenger train service—Lightweight, 42,900 lb.

ordered in large quantities, it would be uneconomical to use aluminum ends.

For the present, we are recommending the use of steel ends, while other parts of the car body, such as roof, doors, etc., are to be made of aluminum with existing tools at no cost premium.

In designing an aluminum box car, more attention must be given to deflection of side-framing members due to bulging loads from grain loading. The vertical deflection is negligible. In the Reynolds design of box car, the side posts are so proportioned that the total moment of inertia is approximately three times the moment of inertia of posts in the A.A.R. design of low-alloy high-strength steel car. It is evident that the stresses in aluminum side posts are less and that they have a greater factor of safety.

Aluminum Hopper Cars

The Reynolds design of 70-ton hopper car shows a weight reduction of 13,832 lb. The weight analysis is shown in Table III. In order to convert the weight reduction in the 70-ton hopper cars to profitable revenue payload, the car body was increased in size by 219 cu. ft. over the A.A.R. standard car with the result that seven more tons of coal can be hauled in the aluminum car.

The aluminum plates are of high-strength aluminum alloy, and the side framing members designed so that the deflection due to bulging load equals the deflection of the steel car, thus lowering the unit stress and increasing the factor of safety. Aluminum rivets are used throughout the car except in the underframe and bolster steel connections.

The Reynolds design of 50-ton hopper car shows a weight reduction of 10,589 lb. The weight analysis is shown in Table IV. In order to convert the weight reduction of the Reynolds 50-ton hopper car to profitable revenue payload, the car body was increased in size by 237 cu. ft. over the A.A.R. standard car, with the result that six more tons of coal can be hauled in this car.

The aluminum plates are of high-strength aluminum alloy, and the side framing members designed so that the deflection due to bulging load equals the deflection of the steel car, thus lowering the unit stress and increasing the factor of safety. Aluminum rivets are used throughout the car except in the underframe and bolster steel connections.

Summary

For design of freight cars, the engineer has a number of aluminum alloys to choose from, but is usually in doubt which alloy will be best suited for a particular part of the car. The alloys recommended for load-carrying framing are, in the order of preference, 17S-T, R 361-T, and R 361-W. Alloys 17S-T and R 361-T

Table III—Weight Analysis of Reynolds 70-Ton Hopper Car with Three-Hopper Arrangement

	Aluminum, lb. Castings and forgings	Sheet and plate	Shapes and bars	Total
Sides	......	2,150	1,803	3,953
Floor	......	2,307	183	2,490
Crossbearers	......	354	227	581
Ends	......	182	436	618
Brake step	......	......	15	15
Underframe aluminum parts	......	63	107	170
Rivets	......	......	240	240
Hopper-door frames (castings)	360	......	......	360
Hopper doors	250	......	......	250
Hopper-door fittings (forgings)	118	......	......	118
Total aluminum	728	5,056	3,011	8,795

Steel and Steel Specialties, Lb.	
Air brake, (ABEL)	678
Air brake, foundation arrangement	825
Hopper-door mechanism	215
Hand brake	125
Center sill, O.H.S.	3,250
Bolsters (Victory)	1,860
Bolster center fillers (castings)	484
Striking casting	330
Cushion coupler carrier and positioning device (straight shank)	44
Body center plates	184
Couplers and yokes, Grade B	1,300
Coupler-operating device	48
Draft-gears and follower plates	710
Draft keys and retainers	111
Safety appliances	260
Miscellaneous	339
Total, steel parts and specialties	10,763
Total, aluminum	8,795
Total, car body	19,558

Comparison with Steel Car	Aluminum cars, lb. Barber S-2 truck	A-3 Ride Control truck	Steel car, lb.
Car body	8,795	8,795	22,737
Specialties and underframe	10,763	10,763	10,763
Trucks	16,570	16,665	16,600
Light weight of car	36,128	36,223	50,100
Load limit	173,872	173,777	159,900
Total load on rail 6-in. by 11-in. journals	210,000	210,000	210,000
Capacity, cu. ft.	3,316	3,316	3,097
Weight of steel substituted by aluminum	22,737	22,737	....
Weight of aluminum	8,975	8,975	....
Weight reduction	13,832	13,832	....
Ratio of pay load to gross load, per cent	82.75	82.75	76.1

Table IV—Weight Analysis of Reynolds 50-Ton Hopper-Car Design

	Aluminum, lb. Castings and forgings	Sheet and plate	Shapes and bars	Total
Sides	......	1,171	1,326	2,497
Floor	......	2,280	172	2,452
Crossbearers	......	353	181	534
Ends	......	158	316	474
Brake step	......	....	12	12
Underframe aluminum parts	......	78	76	154
Rivets	......	....	150	150
Hopper doors	......	282	....	282
Hopper frame casting	330	....	....	330
Hopper-door fittings	56	....	....	56
Total aluminum	386	4,322	2,233	6,941

Steel and Steel Specialties, Lb.

Air brake (ABEL)	678
Air brake, foundation arrangement	725
Hopper-door mechanism	393
Hand brake	125
Center sill, O.H.S.	2,550
Bolsters	1,595
Bolster center fillers (castings)	484
Striking casting	330
Coupler carrier device (straight shank)	44
Body center plates	184
Couplers and yokes, Grade B	1,300
Coupler operating device	48
Draft gears and follower plates	710
Draft keys and retainers	111
Safety appliances	260
Miscellaneous	333
Total steel parts and specialties	9,870
Total aluminum	6,941
Total weight of car body	16,811

Comparison with Steel Car

	Aluminum cars, lb. Barber S-2 truck	A-3 Ride Control truck	A.A.R. steel car, lb.
Car body	6,941	6,941	17,530
Specialties and underframe	9,870	9,870	9,870
Trucks	14,032	13,965	14,100
Lightweight of car	30,843	30,776	41,500
Load limit	138,157	138,224	127,500
Total load on rail	169,000	169,000	169,000
Capacity, cu. ft. (10-in. heap)	2,645	2,645	2,408
Weight of steel substituted by aluminum	17,530	17,530	....
Weight of aluminum	6,941	6,941	....
Weight reduction	10,589	10,589	....
Ratio of pay load to gross load, per cent	81.4	81.4	74.1

have strength equal to that of open-hearth steel and should be used wherever no severe offsetting or forming is required.

R 361-W is recommended for parts requiring severe offsetting or forming. The strength of R 361-W is about one-half of the strength of R 361-T or 17S-T, and if aluminum parts are designed to equal deflection of similar steel parts, usually the stresses will be low enough to use R 361-W. When maximum strength is required, then the formed shapes can be age-hardened to R 361-T. Shapes of 17S-T or R 361-T can be offset or formed by heating the material to 450 deg. F. if not allowed to remain at this temperature for more than half an hour; otherwise, the longer period will affect the temper and cause loss of tensile strength.

For outside sheathing of the car, the aluminum alloys recommended are, in the order of preference, R 301-T, R 301-W, R 301-O, R 361-T, R 361-W, and R 361-O. Alloys in "T" temper should be used for parts without severe bends or flanges and only when the proper bend radii can be used. For parts requiring flanging and some forming, and if proper bend radii can be used, "W" temper alloys should be used. For parts requiring severe forming combined with a draw, "O" temper, which is in the annealed state, should be used. Alloys in the "O" temper can be heat treated to "W" or "T" if strength is required. Whenever heat treating of formed parts is required, the services of an aluminum metallurgist or service engineer should be engaged. In the heat-treating, distortion will vary in intensity according to the size and shape. Hence this caution.

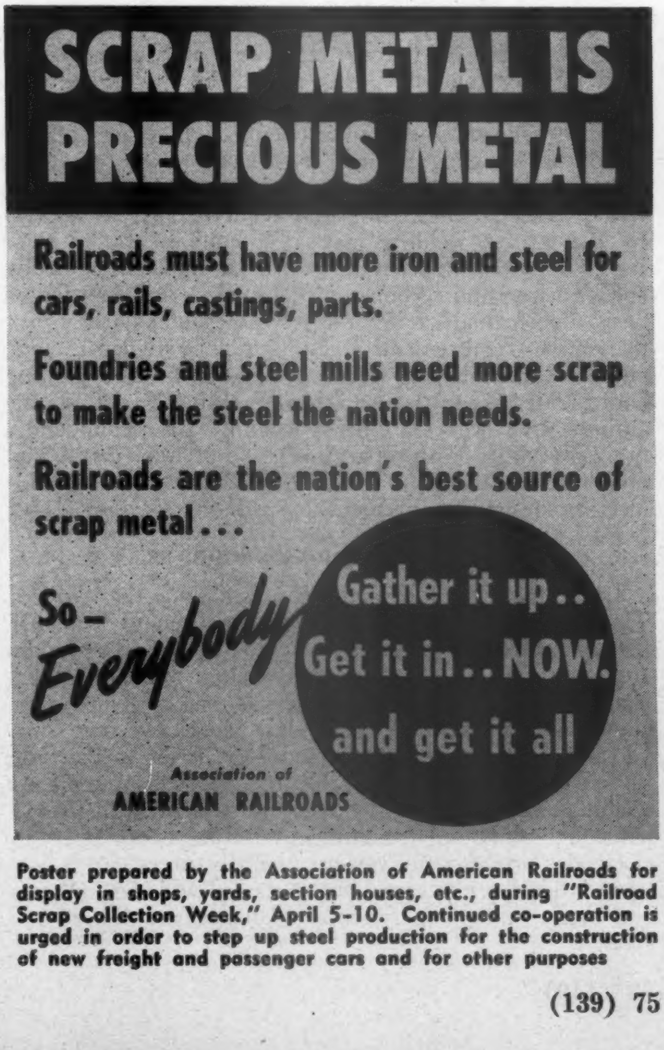
Aluminum alloys for rivets are recommended, in their order of preference, as follows: A 17S-T, 53S-T61 or 53S-W or R 361-W. Usually rivets up to ½ in. diameter can be driven cold with a hand pneumatic or power squeeze riveter. Rivets larger than ½ in. diameter should be driven hot. All riveting, of course, should be done with power squeeze machines. A modified cone head on the driven side is recommended in preference to the button head because it takes less pressure to form such a head and the strength is equal if not greater. An aluminum service engineer should be consulted for information on driving rivets hot.

There are some conditions where aluminum is exposed to alkaline materials. In such cases, proper precaution is necessary, and parts so exposed should be coated with zinc or zinc-chromate paint.

Riveted joints should be weatherproofed with a mastic material which will not harden and will not be injurious to aluminum.

The economics of aluminum freight cars will not be discussed at this time because there is a variance of opinion as to the proper method of determining cost of weight reduction. The railroads do not agree at the present time on the cost of hauling one ton one mile. Figures from one mill to five mills per ton-mile have been used; however, any figure chosen can usually be refuted by any particular railroad as not applying to its operating conditions. But everyone will agree that it does cost a certain amount of money to haul one ton of weight over every mile of railroad; and it is hoped that with Diesel locomotive operation (with which more accurate records of fuel consumption can be maintained) more accurate costs can be developed.

* * *



Poster prepared by the Association of American Railroads for display in shops, yards, section houses, etc., during "Railroad Scrap Collection Week," April 5-10. Continued co-operation is urged in order to step up steel production for the construction of new freight and passenger cars and for other purposes

Railroads and the

American Welding Society

By L. E. Grant

A discussion of relations between the Society, which has been largely responsible for advance of welding techniques and expansion of applications, and the railroads which have long benefitted from the art

[Mr. Grant, in preparing this discussion of the relations between the American Welding Society and the Railroads, is expressing the opinion of the Cutting and Welding Committee, Electrical Section, Mechanical Division, Association of American Railroads, of which he is chairman. On the committee with Mr. Grant, who is engineer of tests of the Chicago, Milwaukee, St. Paul & Pacific, are F. F. Hayes; John Hengstler, supervisor of welding, Altoona Works, Pennsylvania; M. A. Herzog, chief chemist, St. Louis-San Francisco; F. A. Longo, general boiler inspector, Southern Pacific; J. S. Miller, supervisor welding, New York, New Haven & Hartford; Robert Moran, welding supervisor, Missouri Pacific; H. A. Patterson, supervisor of welding equipment, Atchison, Topeka & Santa Fe; A. F. Stiglmeier, general supervisor boilers and welding, New York Central System, and B. G. Wollard, system welding instructor, Chicago & North Western.—Editor].

THE December, 1947, issue of the *Railway Mechanical Engineer* has an editorial relative to the desirability of greater and more effective cooperation between the railroads and the American Welding Society. This is a significant topic to the members of the Cutting and Welding Committee of the Electrical Section of the A.A.R. and it is one which has been discussed many times at meetings of this committee. The editorial presents a number of reasons for this cooperation but the committee believes there are additional ones for promoting this cooperation and have suggested that through the writer, who is chairman of the committee, this matter be discussed more extensively.

Since its organization over twenty-eight years ago, the American Welding Society has served to keep industry informed of the new developments in welding, cutting, flame treating, metallizing and related topics as well as to standardize welding materials, equipment and their use. Standardization in the form of application codes, specifications and recommended practices has served as a basis of information for industry and also as a basis for mandatory requirements for adoption by Federal, state, and city authorities as well as for industrial code-writing bodies. All look to the American Welding Society as the authoritative organization on welding for recommendations covering joint preparation, type of filler metal, and other factors which are involved in securing sound welds meeting design requirements.

Electrode Specifications

In the matter of welding electrodes alone the work of The American Welding Society has been of immense benefit to the railroads, although this is very often taken for granted. The A.W.S. in conjunction with the American Society for Testing Materials has developed the standards for welding electrodes which are now universally used throughout the industry. Prior to the time these standards were available the railroads purchased welding electrodes on the basis of the manufacturer's name or brand only. Significant differences existed in electrodes produced by various manufacturers and it was very difficult, without making an extensive series of tests and many costly experiments, to obtain the desired results.

This undoubtedly was a contributing cause to the rejection of welding for some operations and also the basic source of some restrictions which still exist. It was difficult for the stores department to keep available the kinds of electrodes desired by the various departments. With the advent of the A.W.S. specifications for electrodes this situation was remedied. All of the electrodes of one type, Class E-6010 for example, are covered by the A.W.S. specifications and all manufacturers must meet the minimum requirements of these specifications. This makes it possible for the stores department to stock only one of the many available brands and yet be assured that results in the shop will be entirely satisfactory. With the huge quantity of electrodes now being purchased by the railroads it is easy to imagine what a chaotic condition would exist without such a standard as the A.W.S. has provided.

The A.W.S. specifications are not limited solely to ferrous electrodes; they now cover rods for gas welding as well as some special electrodes such as aluminum. It is probable that in the near future they will also cover the entire field of non-ferrous filler metals.

Standard Qualifications and Procedures

The American Welding Society has set up standards for qualifications of both welding operators and procedures for welding. The railroads benefit from this other than by simply having available a suitable standard for testing and qualifying welders. The manufacturers who build equipment for the railroad's, such as locomotives, cars and machine tools, in which welding may be used, also make use of these same standards for qualifying their operators and procedures, thus helping to insure that the products they furnish will be adequately welded and suitable for the service for which they are intended. Such manufacturers not only use the qualification procedures, but they also made use of the specifications for welding rods.

The monthly journal published by the A.W.S. is a mine of information on welding and much of this is useful to the welding men on the railroads. The articles cover all phases of welding, brazing, cutting, pre-heating, postheating, metallizing and many of the practical problems pertaining to welding, such as control of distortion and shrinkage. One cannot read this journal consistently without deriving an enormous amount of help on everyday problems. Some of the subjects naturally pertain to

railroad practices as some men on the railroads find time to report how they have done specific jobs. There are also reports by the various manufacturers of welding equipment explaining how their equipment is being used in railroad work. All of these, of course, are very helpful to the railroad men. Unfortunately not nearly enough men concerned with welding on the railroads are members of the American Welding Society and receive the journal regularly. The committee believes that membership in the A.W.S. would be a good investment for the railroads and their men even if the journal were the only return.

Publications

The A.W.S. publishes a great deal of useful information other than that which appears in the monthly journal. There is, for example, the A.W.S. Handbook, a 1,500-page reference book covering all phases of welding problems. Other publications are sponsored by the Society, such as the book on Welding Metallurgy, by Henry and Classen. This book is a simple but comprehensive explanation of the part that metallurgy plays in welding. An understanding of the principles set forth in this book is essential to any welding engineer or conscientious welding inspector. The Inspection Handbook for Manual Arc Welding and the Standard Methods for Mechanical Testing of Welds are other valuable books with which every welding engineer should familiarize himself.

The monthly meetings of the local sections of the American Welding Society in various cities are a source of information, sometimes along the same lines as articles published in the journal, but more often are a fairly complete discussion of new developments or practices with many practical illustrations in the form of slides or weld specimens. Attendance at these meetings provides one with an opportunity to keep up to date with new developments and to discuss problems with others who may have had experience with similar ones. A great deal of helpful discussion goes on at such meetings, some of which is more helpful than material that is published. If a railroad man is not located in a city where there is an opportunity to attend local section meetings regularly it is even more important that he join the A.W.S. for the benefit he can get from the journal and attendance at the annual meeting.

Annual Meetings

The annual meeting of the A.W.S. provides an opportunity to evaluate all the latest developments in welding and cutting equipment and to attend meetings where papers on new developments are presented and discussed. Many of the foremost men engaged in welding attend these meetings. This is an excellent opportunity to meet and come to know them.

When one looks back over the last fifteen years and appreciates the tremendous developments that have taken place in welding, it is obvious that only by maintaining continuous contact with such development can one keep abreast of this art. The railroads should be as eager in the future as they have been in the past to adopt welding practices which will enable them either to reduce costs or reduce the time required to repair equipment that is held out of service. Only by association with such a group as those comprising the American Welding Society can this be done effectively, conveniently and comprehensively. New developments which are exhibited at the annual meeting may not be subjects for publications for several months later. Those who attend these meetings and inspect the exhibits are ahead of those who fail to attend. They may in many cases have the new equipment installed and in actual service in their shops before any published material pertaining to it has appeared.

The railroads have benefited greatly from the activities of the A.W.S., both directly and indirectly. They should help to support the work of the A.W.S. by encouraging their people who are interested in welding to join the society and take an active part in its activities. The membership records show that an extremely small number of railroad men are members of the society; certainly the proportion is insignificant in comparison to the volume of welding work being done by the railroads. It is not a satisfactory arrangement to have the railroads represented only on the benefit end and not on the contributing end. They can contribute greatly by encouraging their men to join the society and attend local section meetings and by making it possible for them to attend the annual meeting. These men should be encouraged to participate in the work of the society by serving on committees and in local-section work. The cost of the membership for a reasonable number of men, or as a sponsor member of the American Welding Society is so trifling a sum and the benefits so great that management can certainly justify effective support of the American Welding Society.

Protect the Railroads' Stake in Welding

Welding is a relatively new industrial process, one that has grown at a rapid rate but one which offers great promise of increasing benefits to the railroads. There is much yet to be learned about welding processes, and even more about its applications. Time, effort, and money must be spent in finding the answers.

The A.W.S. has attempted to assist the railroads by sponsoring the organization of a Railroad Welding Committee. This committee offers a meeting ground for representatives of railroads, car builders, locomotive builders, and interested government agencies for exchange of information and discussion of common problems. The committee has been in existence over two years but has not accomplished as much at it should have in this time largely because the railroad representation is much to small. The railroads have been reluctant to permit men from their organizations to accept membership in the society.

The industrial representation is strong and has been active, indicating that the committee fills a real need. With effective support of the railroads and the cooperation of the A.A.R. it could accomplish much that would be of value to both the railroads and the supply industries, thus paralleling the experience of other similar committees which have been sponsored by the American Welding Society. The A.W.S. further assists this committee by having its technical secretary serve as the secretary of the committee. The chairman of the committee at the present time is also chairman of the Cutting and Welding Committee of the Electrical Section of the Association of American Railways. This arrangement should make for effective coordination of these two committees.

Diesel Locomotive Inventory.—According to statistics compiled by the Railway Age, there were 6,548 Diesel locomotive units in service on domestic railroads as of December 31, 1947, of which 5,919 were owned by Class I railroads and 629 were owned by terminal and switching companies and Class II and III railroads. Diesel road units operated by Class I railroads totaled 3,003 with an aggregate horsepower of 4,670,010, which is 93 per cent more horsepower than that of the 2,916 switching units in service for railroads in the same class. The Diesel locomotive inventory of Class I railroads was increased in 1947 by 1,340 units, of which 25 were 3,000 hp., 211 were 2,000 hp., 799 were 1,500 hp., and the remainder 1,000 hp. or less.

Fundamentals of

No. 6-BL Brake Equipment*

By H. W. Sudduth†

THE No. 6-BL Brake for switching and branch line locomotives which will soon be on stock locomotives of those classifications is fundamentally the same as the 14-EL and the 6-ET, but it has a self-lapping independent brake valve. Functionally, it is like the 6-DS.

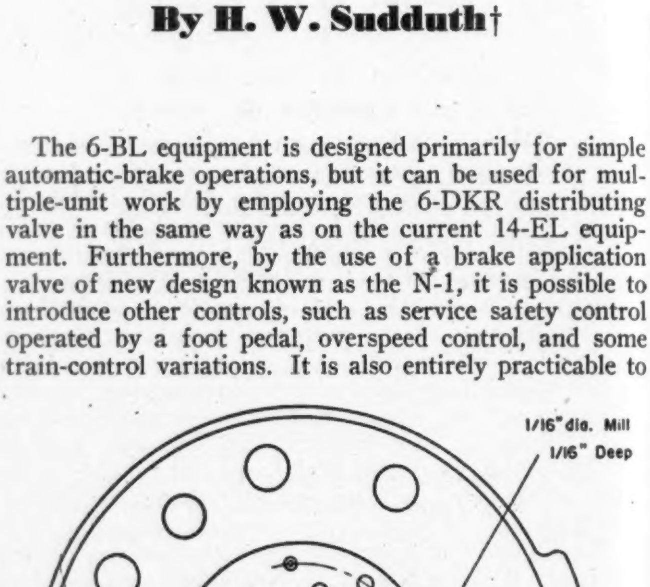
The locomotive builders asked us for a switch-locomotive and simple automatic brake for a 1,000- or 1,500-hp. branch-line locomotive that would fit well into a Diesel cab and have fairly simplified piping. The 6-BL is designed with an automatic brake valve of the H-6 type, and the standard H-6 brake valve can be used with it. The self-lapping independent brake valve is known as the LA-6. There is a pipe-bracket mounting for these brake valves which will allow knee room for the engineman. It also has on the same mounting bracket a bell-ringer valve and a simple sander valve. There is a manifold-type feed-valve pipe bracket to which is bolted the double-heading cock. This bracket is built so that the feed-valve mounting face protrudes through a bulkhead or a front cab wall, so that all piping is in behind, but the feed valve itself is on the engineman's side. At the same time, the double-heading cock is mounted to the manifold bracket so that its handle protrudes through the wall and is on the engineman's side. In the manifold bracket the main air pipes are connected so that they present a neat piping arrangement to the back of the brake-valve pedestal itself.

The other parts of the equipment are the normal No. 6-K distributing valve, the brake cylinders used by the locomotive builders on their particular trucks, angle cocks, cut-out cocks, etc. The mounting bracket for the H-6-L brake valve is made in such a way as to accommodate some variations. For instance, the H-6-V brake valve may be used. The feed valve is the F type, with internal remote-control pipe known as the F-3-D. The remote-control pipe is in the feed-valve mounting face, but there is a provision for the use of a standard F-3-B feed valve with a separate remote-control pipe if desired.

As in other air-brake apparatus, feed valves of other types can also be mounted by the use of proper adapters and proper length cap screws or studs. The F-3-D feed valve has no warning-port check valve in it, and hence, with the H-6 brake valve, a supply of air for the continuous warning port in release position must be found in some other way than the standard 6-ET. When any feed valve with a remote-control pipe is subjected to a high-pipe pressure, it closes tightly and therefore does not provide a supply for the normal warning port.

A small change can be made in the H-6 rotary-valve seat which will provide a constant supply of air for the warning-port function. While many people do not now make use of that, a continuous warning port function can be attained in a standard H-6 brake valve by milling a channel 1/16 in. deep by 3/16 in. long. We have incorporated it in standard H-6 brake valves. Outside of that, everything in the equipment, aside from the self-lapping independent brake valve, is standard to 6-ET and the current 4-E.

The 6-BL equipment is designed primarily for simple automatic-brake operations, but it can be used for multiple-unit work by employing the 6-DKR distributing valve in the same way as on the current 14-EL equipment. Furthermore, by the use of a brake application valve of new design known as the N-1, it is possible to introduce other controls, such as service safety control operated by a foot pedal, overspeed control, and some train-control variations. It is also entirely practicable to install a GRS actuator top on the H-6 brake valve. Some of the simple GRS train-stop systems can be used in that manner.



Modification to the H-6 brake valve rotary seat to provide continuous warning port function

Discussion

H. I. Tramblie, air brake instructor, Chicago, Burlington & Quincy, asked why the type SF or O brake valve was not used in place of this one merely for the purpose of standardization, as the independent valve used differs from other self-lapping brake valves on late-design locomotives.

Mr. Sudduth replied that the independent brake valve is the same as is used on the 6-DS, the LA-6P pedestal. The self-lapping unit in it is exactly the same as those used in the S-40 brake valves, the SA-2 brake valve, and others of that nature. The housing for it is not the same, and the reason for that is that there are some check valves and cams in it operated by the handle which have to be there functionally.

Chairmain Peck inquired if the No. 6-BL will be stock for switching and branch line locomotives only. Mr. Sudduth replied that it will be on switch locomotives first,

(*Continued on page* 80)

*From a paper presented before the convention of the Air Brake Association held at the Hotel Sherman, Chicago, September 15-17, 1947.

†Director of air brake engineering, New York Air Brake Company, Watertown, New York.

Research Institute Develops

A High-Pressure Boiler

Design of Steam Locomotive Research Institute includes closely spaced water-tube walls in firebox and a fire-tube barrel—Suitable for 600 lb. per sq. in. pressure.

ONE of the projects to which the Steam Locomotive Research Institute has given considerable study is the design of a locomotive boiler which will operate satisfactorily at a pressure higher than the present usual maximum of 300 lb. per sq. in. The Stephenson locomotive boiler with its water-enclosed firebox and fire-tube barrel has inherent technical and mechanical advantages which have given it a practical monopoly in steam locomotive practice. It's one constructional weakness has been the firebox with its flat walls supported by staybolts. As pressures have gone up, staybolts have come closer together, water circulation has been impeded, and maintenance costs have increased. At current boiler pressures the major part of locomotive boiler maintenance cost is given to firebox repairs.

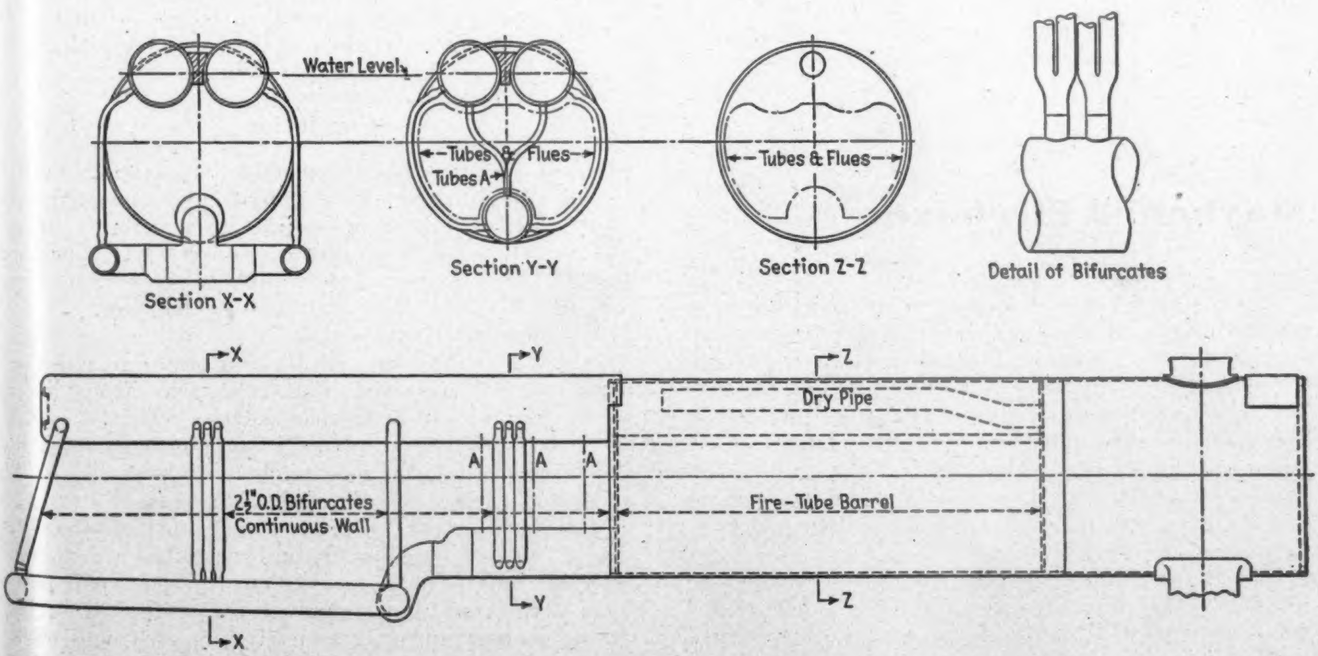
It is generally conceded that boiler pressures of 300 to 325 lb. per sq. in. represent the practical maximum for staybolted fireboxes. From the prime mover standpoint, higher pressures offer the advantage of greater power within the same space and also greater thermal efficiency. It is believed that a pressure of 600 lb. per sq. in. could be used with advantage in American railroad practice, the prime mover being modified to take full advantage of the greater possible expansion. The conventional single-expansion cylinders would be replaced by uniflow, multiple-expansion, or turbine operation.

With the present trend to higher thermal efficiency, it is definitely desirable to provide a locomotive boiler for higher steam pressures, and with firebox maintenance minimized.

In view of stationary practice, it is natural to think first of a water-tube type boiler. However, extensive comparative study by the Steam Locomotive Research Institute has shown that after the gases of combustion leave the firebox, the intensive heat absorption required to produce a compact locomotive boiler can be obtained more efficiently with a fire-tube barrel than with any other tube arrangement. This conventional barrel does not limit the pressure and has the great advantage of being a strong structural element in the anatomy of the locomotive.

The advantages of a locomotive firebox with water-tube walls have long been recognized in America and Europe. Mny designs have been made and a considerable number of boilers have been built. The advantages have been demonstrated, but certain constructional troubles have developed. A recent survey of the situation by the Institute has led to the conclusions that many of the difficulties with earlier designs of water-tube fireboxes can be avoided by using modern methods of boiler construction as developed in stationary practice. Stationary boilers with water-tube fireboxes are built today for pressures up to 1,250 lb. per sq. in. With modern methods and materials there should be no serious difficulty in building a locomotive boiler for 600 lb. per sq. in.

The design developed by the Steam Locomotive Research Institute follows closely the outline of a conventional locomotive boiler and can usually be built to fit



A high-pressure locomotive boiler with water tube firebox and fire-tube barrel

an existing chassis if desired. Grate area, firebox, and combustion chamber are arranged as in a conventional boiler. No staybolts are used. The firebox and combustion chamber walls are closely spaced bifurcated tubes of the type used in high-pressure stationary boilers. These tubes terminate in a top drum or drums forming the roof of the firebox and in a smaller diameter bottom drum.

In earlier locomotive water-tube fireboxes the tubes were rolled into the drums. This required a rather wide space between tubes and insulation was difficult. In the Institute design the use of bifurcated tubes welded into the top and bottom drums provides a practically continuous water wall.

It should be noted that the use of water-tube firebox walls reduces greatly the damage likely to occur in the case of low water.

No. 6-BL Brake Equipment

(*Continued from page 78*)

but it is proposed for branch-line locomotives where no complications of elaborate train control are involved and where rather simple automatic brake operation is all that is necessary.

Mr. Tramblie mentioned that his reason for introducing the subject of the independent brake valve was that there are now so many different parts of equipment that it is becoming burdensome. Standardizing on some items would help. One thing this organization should do is to try to standardize so far as we can the different types of equipment that are applied to different types of locomotives and cars.

Chairman Peck said that it occurred to him that the test plates for the AB-T-6-B, the 6-D, and the 6-C test racks will buy a new 4-C test rack. Each time a new device comes along, testing facilities must be obtained to maintain it properly. The days are over when a man can tell by his eye whether a device has been properly repaired.

Mr. Sudduth said that on the 6-BL everything standard that could be used was used, and that the new self-lapping independent brake valve has as many parts in it as could be found that were common to current self-lapping brake valves. When new functions are involved, it is often necessary to depart from what has been formerly standard.

Staybolted Fireboxes

(*Continued from page 69*)

Tests completed in October, 1946, on welded vs. screwed staybolts (conducted under the direction of a special A.S.M.E. Committee on welded stay construction in power boilers under the chairmanship of W. D. Halsey) have resulted in the acceptance of the fusion welded-stay in lieu of threading. The fusion-welded staybolt was proposed for locomotive boilers during a meeting of the Master Boiler Makers Association, five or six years ago, and a limited amount of test work has been undertaken by one of the leading roads.

In view of the present status of fusion welding as a reliable method of construction and the inherent strength, ductility, and other desirable properties of the fusion welded joint, it seems reasonable to predict that its adoption as a permissible staybolt fastening in locomotive boilers may be expected.

The formulating of rules for welding staybolts to assure safe practice in all railroad shops where welding is apt to be used can be expected to present difficulties, due to the refusal in some shops by the welders to qualify, seniority rules which can result in unskilled welders doing the work, and other factors. It is unfair to the large number of railroad shops where procedure controls can be applied and good work done to penalize them through rules and regulations aimed at those shops where proper work is not being produced and where controls operative in modern fabricating shops are not now being exercised.

During the time this rather knotty problem is being studied, welding engineers, in cooperation with boiler designers, could well give thought to the requirements to be met in providing a proper fusion-welded stayed structure for locomotive service. The essential difference between stationary and locomotive boiler operation is in the greater severity of stresses imposed on the staybolts and fastenings in locomotive fireboxes, from the rapid temperature changes encountered during cooling-down, boiler washing, firing-up and often misuse of boiler feed pumps and, to a lesser degree, the variations in firing rates. These stresses, often exceeding the yield point of the staybolt material, are bending stresses superimposed upon the static tensile stress due to the boiler pressure. The use of upset ends on the welded stay with a more liberal allowance of the maximum permissible stress due to boiler pressure in the body of the stay can be expected to effect improved stress distribution and to lower maximum stress concentrations.

In view of the paucity of reliable data on the staybolted structure as a whole, the introduction of the fusion-welded stay could well promote an early start on a research project under the sponsorship of the A.S.M.E. The results of the tests should be more readily accepted by the Bureau of Locomotive Inspection and the roads if made in either locomotive boilers, or if need be, in locomotive-type boilers such as used in the oil fields.

Research of this nature is best conducted in a test plant by a railroad testing organization where means are available to closely simulate locomotive boiler handling and operating conditions. These could include dumping of the fire, rapid cooling-down and firing-up, introduction of cold feed water through side boiler checks and other conditions likely to impose the abnormal thermal shocks largely responsible for firebox failures.

Conclusion

In conclusion, it may be said that the staybolted firebox is well suited to meet the requirements of modern locomotive boilers. The stayed structure is inherently strong, and yet adequate flexibility or, if necessary, controlled rigidity is readily provided by suitably proportioning the spacing, sheet thickness and staybolt diameter.

Modifications could well be made in the present design practices to obtain greater benefits from improved materials and methods of construction. More liberal working stress allowances than are now permitted in code and safety rules seem advisable for the higher working pressures in use today and are obviously necessary if the staybolted firebox is to be used for pressures up to 500 lb. per sq. in. or so desired for steam turbine drives. It can be further stated with confidence that a very considerable improvement in maintenance and repair costs, reliability, safety and weight of the staybolted firebox can be obtained through relatively minor changes in design and the use of modern materials properly applied.

EDITORIALS

A Way to Lower Steam Locomotive Maintenance

A needless handicap which has long hampered improved design and lower maintenance cost of steam locomotives is the failure to utilize more extensively developments of other industries and basic research that is applicable to a broad category of mechanical design. Staybolts serve as a typical example of the failure either to use or to investigate knowledge that is available. While a present-day staybolt is unquestionably better than one of 50 years ago, it is quite probable that the staybolt is nowhere near as good as it can be made. A significant factor in staybolt design where tremendous improvement is both possible and valuable is the elimination of stress concentration where the bolt is threaded to the sheets. The stress concentration in this portion of the staybolt metal causes it to bear far more than its share of the load. Like the chain which fails at the weakest link, that part of the staybolt also fails that is the most highly stressed because it is least able to support the load imposed upon it.

Some recognition has been given to the solution of the problem of staybolt cracking and breaking by bulging the sheets inward or outward at the staybolt hole. This reduces the crowding of the lines of force and thereby helps to distribute the stress more evenly. Outward bulging also has the advantage that the pull of the staybolt tries to close the hole; this helps to simplify the caulking problem and makes caulking itself easier. Far more can still be done, however, the ground work for which has been laid and proved by application in other fields. Stress-relieving grooves are well known and widely used to increase fatigue resistance. Their ability to distribute the lines of force more evenly should be useful in staybolt design for distributing the stress more uniformly over the full length of the thread. Similarly, rolling the thread to determine the effect on strength may have a favorable effect and deserves investigation.

And why stop at improving only threaded staybolts? The astronomical number of staybolts in use on the steam locomotives of the country and the countless number renewed every day make well worth while research directed toward eliminating entirely the need of threading. The possible saving in time, money and labor is huge. At least one such successful design has proven satisfactory in European practice. The sheet is not threaded; the bolt merely slips into it. It is rolled to a tight fit through a bowl-shaped opening in the end. The bolt is then welded along its outer circumference to the hole in the sheet.

Experimental designs can be tested in road service without running the risk of locomotive failures en route or of removal from service to correct any defects that may appear in preliminary designs. The Bureau of Locomotive Inspection requires that a boiler be removed from service if two adjacent staybolts are broken or plugged, three or more in a circle four foot in diameter, or five or more in the entire boiler. No risk of removal from service will, therefore, be entailed from experimental staybolts if the number is limited to four for the entire boiler; little risk will be run if two per four-foot circle are installed.

The advantages of reducing the stress concentration in staybolt threading or eliminating threading entirely are numerous. The limitation on boiler pressure due to staying side sheets can be raised if staybolts are strengthened; where higher pressure is not desired, either smaller bolts or fewer bolts can be used. Opportunities for overall operation to be improved and utilization increased are presented with any improvement to any part of the locomotive. Better stress distribution in the vicinity of the threaded areas of both the staybolt and side sheet will increase boiler reliability and reduce boiler maintenance. If a suitable threadless staybolt can be developed the savings from eliminating the threading operation in the bolts and sheets can easily result in a drastic cost reduction in this part of boiler construction and maintenance.

25 Million Horsepower

"Today, there are more than 25 million horsepower in electrical transmissions on American transportation systems, and they are being purchased by the railroads at an annual rate of slightly less than 5 million horsepower. At this rate of application, within 10 years' time the electric power in locomotives will exceed that now being developed by all the present central station generating plants."

The foregoing statement was included in a paper presented by Gwilym A. Price, president, Westinghouse Electric Corporation, before the New York Railroad Club in New York, on March 18, 1948. It is scarcely probable that the railroads' use of electrical machinery for traction applications will equal that in the Central station field. They too must add much to their plant capacity, and changing circumstances may improve the status of the reciprocating steam locomotive. Mr. Price's statement, however, serves strongly to emphasize the significance of the present growth and size of electrical railroad applications.

The figures given include electric as well as Diesel-electric locomotives. They also include steam-electric locomotives such as those on the Chesapeake & Ohio, and they will include gas-turbine locomotives. They do not include the geared steam-turbine locomotive. Concerning this unit, Mr. Price said, "But if the steam-turbine locomotive is to match the efficiency of the Diesel-electric, it is apparent that there must be some marked improvements in the boiler and firebox". These are now in process.

A number of gas-turbine power plants for locomotives are now in process of development. One of them was demonstrated recently on a test stand by the General Electric Company at Schenectady, N. Y. It developed

4,800 hp. at a turbine speed of 6,700 r.p.m. It is operated under load at speeds down to 6,000 r.p.m. It must be "cranked" to a speed of 2,000 r.p.m. before it can be fired. These characteristics indicate that nothing but an electric transmission could be used with such a power plant. If the gas-turbine finds a place in the railroad field, it will apparently add its share of electrical transmissions to the railroads' total.

Railroad applications of electrical transmissions may not continue their present rate of increase for ten years, but even the present total is requiring drastic changes in operating and maintenance procedures. If anything like the suggested increase occurs, it is evident that railroad electrical maintenance facilities and forces must be expanded to several times their present size.

Maintenance Policies And Maintenance Cost

The Diesel-electric locomotive, because of its many inherent operating advantages, is of such great value to the railroads in their present efforts to effect economies that it would be tragic indeed should its use be handicapped by unjustified expense of operation or maintenance resulting from the adoption of too hastily considered policies.

Some railroads seem to be headed in the direction of the establishment of facilities which will make them self-supporting with respect to locomotive parts. This is not surprising for they have pursued this course for many years in the past when the problem of producing repair parts of satisfactory quality was a much simpler one than it appears to be with respect to Diesel locomotive parts and because, too often, there was no other way in which to protect their service than to fall back on their own shops.

So far, the builders of Diesel power have done a remarkably efficient job in setting up supply sources for replacement parts. This makes it unnecessary for most roads to think in terms of repairing or manufacturing their own parts. As the volume of work increases, due to the increasing number of Diesel-powered units in service, the pressure of economy in cost or the immediate availability of supply will force mechanical officers to give more and more thought to this problem.

Several factors appear to favor the policy of securing standard replacement parts either from builders of the original equipment or from suppliers recommended by those builders. Among these are the matter of engineering standards, the quality of the material and the standard of workmanship. The builder of the original equipment designed each part in the process of designing the complete machine and experience in the functioning of the complete machine broadens his ability to design and produce replacement parts that will function with the greatest reliability. In relying upon outside sources the railroads should always be assured of obtaining replacement parts into which have been incorporated the cumulative experience of the builder in the correction of difficulties with respect to materials or performance in service. Every railroad mechanical engineering department has always endeavored to approach an ideal with respect to the correction of service defects by collecting and analyzing reports of service failures as a result of poor design, poor materials or poor workmanship. In the case of Diesel power the builders have a record of parts performance that is nation-wide in scope and the railroad which relies on the builder for parts profits by the experience of all other railroads using that type of equipment.

A most important factor relating to replacement parts is that of price. In determining the policy of an individual road it is highly important that there be no confusion as to the relation between the price of a part and the ultimate cost of its use. While the price today may seem high, a part of that higher price is a guarantee as to quality, as to responsibility for performance and assurance that the latest improvements that are dictated by experience have been incorporated in the parts that are furnished.

Estimates have indicated that there are some 40 or more millions of dollars worth of Diesel locomotive repair parts on the storehouse shelves of American railroads. How much higher this estimated inventory might be were it not for the supply facilities of the builders is anyone's guess. As time goes on and the volume of work increases there will be many repair parts that the railroads can and will produce because they now have production capacity for doing this kind of work which they can not or should not abandon. The real problem is to adopt a course which will maintain a fine balance between the price of parts which *should be purchased* and the real cost of using parts that are produced in railroad shops. It is not so much a matter of weighing one of these against the other as it is of weighing the influence of each on the final cost of locomotive maintenance.

Welding Restrictions

There is no question in the minds of engineers and metallurgists about the inherent advantages of welding in the construction and repair of locomotives and cars. In recognizing, however, the desirable physical properties and economies obtained by welding these men would be the first to admit that welding must be done by trained operators under competent supervisors who know what can and can not be welded and how to do the job if welding is used. It is the lack of this knowledge of the welding process and its limitations that has been the cause of considerable grief to the railroads in the past and will continue to handicap the railroads in the future in making full use of the potentialities of welding.

In an article dealing with the design and construction of fireboxes appearing elsewhere in this issue the late F. P. Huston raises some important points on the restrictions placed on welding when he discussed the use of fusion-welded staybolts. He said, "The formulating of rules for welding staybolts to assure safe practice in all railroad shops where welding is apt to be used can be expected to present difficulties, due to the refusal in some shops by the welders to qualify, seniority rules which can result in unskilled welders doing the work, and other factors. It is unfair to the large number of railroad shops where procedure controls can be applied and good work done to penalize them through rules and regulations aimed at those shops where proper work is

not being produced and where controls are not now being exercised."

These statements are somewhat contradictory. If some railroad shops can establish procedure controls and qualify welders there are no good reasons why all welders in all shops should not be qualified to perform the work they are paid to do and controls should not be established in all shops. If operators are not qualified then they should not be doing welding work. Granting that there are some difficulties in getting the right men for the job it would appear that the greatest handicap must be either that the shop management does not appreciate the need for procedure controls or the welding supervisors are not competent to train and qualify the men under their control.

If the restrictions contained in the rules and regulations of the Interstate Commerce Commission and the Association of American Railroads are to be eliminated all railroad shops must use only trained welders and establish recommended procedures. Otherwise the railroads will continue to be penalized by being unable to take full advantage of this highly developed art.

Measuring Mechanical Department Performance

Looking at the work of railway mechanical departments broadly, there is nothing more important than setting up performance goals, measuring what is actually accomplished, awarding commendation for a good job, discovering and correcting the reasons for a poor one. Competition is still a potent force in the American way of life and consequently it is desirable to set up mechanical department performance figures on a basis so that each locomotive or car-repair point, enginehouse, division, or the railroad as a whole, can compare its record of achievement month by month with itself and with what comparable neighboring units are doing.

The first thing to look at its production, as reflected in locomotive-miles, car-miles, ton-miles, train-miles, etc., since the volume of work done dictates in many instances the general policy which must be followed in doing it. For example, a prospective increase of 10 per cent in gross ton-miles for the ensuing year may mean that new freight locomotives must be purchased, repair programs speeded up, or more intensive use made of present power. Generally all three steps, in some combination, are taken in an attempt to solve the problem.

Similarly something must be done about freight cars needed for the additional business. And this means analyzing the figures of equipment owned and leased, cars in shop or awaiting repairs, miles made per car per day and all of the numerous things which can be done to step up the latter index of performance. With passenger train-miles and car-miles at a lower level than any year since before the war, the opportunity and necessity for planning passenger-car and locomotive programs of purchase and maintenance to produce the most efficient and economical service is apparent.

Fuel performance figures are worth recording and comparison, because fuel purchases account for roughly one-third of all railway expenditures for materials and supplies. Too little emphasis has been placed on this feature in recent years partly due to the urgent necessity of moving huge volumes of traffic during war years, regardless of cost, and partly because of increasing difficulty, with substantial amounts of Diesel power, in developing conversion factors which will not invalidate any comparisons made. The number of pounds of coal consumed per 1,000 gross ton-miles on Class I railroads was 111 in 1941 and 116 in 1946.

Locomotive and car failures, both numerically and on a mileage basis, are examined with the greatest care by railway operating and mechanical officers alike. In general, the miles per failure in freight service are two or three times as great as in passenger service, probably due to relatively lower speeds, and may exceed 200,000 miles. On one large system, operating a substantial amount of Diesel power, the total miles per failure was almost 40 per cent greater in 1947 than in 1946 indicating some pretty intensive and effective work in setting up comparative figures, locating weak spots, tracing causes, applying remedies and, of course, improving the general standard of maintenance. In this connection, it is interesting to note that the greatest improvement was made with steam power, the number of miles per failure in 1947 being over 50 per cent greater than in 1946 and exceeding the miles per failure secured with Diesel power.

Cost of repairs, locomotive, freight-car and passenger-car, are highly significant in view of the fact that the total maintenance-of-equipment bill on a large railway system may approach or exceed 100 million dollars a year. Repair costs, when set up on the basis of locomotive-miles, car-miles, or 1,000 gross ton-miles, are especially valuable for comparison purposes and may be used to stimulate competition and improvement of facilities and methods at individual repair points. Enginehouse expense still amounts to several million dollars a year on most roads and deserves constant checking and analysis in the interest of economy.

Similarly, only on a larger scale, the total mechanical-department payroll constitutes roughly 60 per cent of the cost of maintaining equipment and must be kept within budget limits and balanced against work actually done. This figure also may be set up on a 1,000 gross ton-mile basis for comparing individual division and district performances. For example, if one division shows a decrease of say 5 per cent while an adjoining district registers an increase of 7 per cent in payroll per 1,000 gross ton-miles, some interesting questions are immediately raised.

Railroads are required by law to keep a mass of statistics, some of which unfortunately go into the archives and are never used. It is vital, however, for mechanical as well as all other railway departments to develop and record accurate figures covering the salient features of their respective functions in rail transportation, make these figures available with the least possible delay and then teach all officers and supervisors how they can use them to the best advantage.

THE READER'S PAGE

Freight-Car Weight Savings with Modern Materials

TO THE EDITOR:

In your February issue five aluminum hopper cars are described which were built by the Illinois Central in its McComb, Miss., shops. These cars were described briefly as follows:

"Completed just in time for the railroad's Christmas, the five new 50-ton hopper cars present a silver-like finish, with black trim and lettering, as they prepare to take the road with a combined saving in weight equal to the entire empty weight of an all-steel car. On a loaded basis, the saving in weight per car will equal about one-tenth of the pay load such a car can carry.

"The light weight of the experimental car is about 37,400 lb. as compared with 47,300 lb. for an empty all-steel car of similar capacity. This is equivalent to a weight saving of 21 per cent or 9,900 lb. per car, or approximately a million pounds on a 100-car train."

An analysis of the foregoing weight comparisons provides results interesting to ponder. To begin with, one would have thought hopper cars of 50-ton capacity, weighing as much as 47,300 lb., were as extinct as the dodo bird. Cars of such extreme dead weight and consequent low carrying capacity have not been heard of, so far as the writer's information goes, for many years. Many cars for various railroads built of similar construction over recent years have weighed little more, if any, than required to continue the use of the single-acting AB brake; namely, 40,600 lb. On such a basis of comparison, the difference in weight between the aluminum car and cars of conventional steel construction would be the difference between 37,400 lb. and 40,600 lb. or 3,200 lb. each. Putting this figure in the equation used above would result in a saving of slightly less than 8 per cent as compared with 21 per cent, and a decrease in the dead weight of a 100-car train of only 320,000 lb. rather than the one million pounds claimed.

But there are still more important considerations. Though this aluminum car does not achieve a very substantial weight saving when compared with a conventional steel car of riveted construction, it nevertheless would require the application of a compensating load brake, whereas the steel car would not. The difference in cost between these types of braking equipment is substantial and likely to be prohibitive unless a greater weight saving is effected than that achieved in this aluminum car.

If the five aluminum cars, evidently built of parts salvaged from dismantled equipment, were reconstructed for some special service such, perhaps, as carrying sulphur, the construction might be justified. However, it is stated that the cars are to be put in coal service and the impression given is that considerable numbers of them may be built for operation in 100-car trains. Otherwise the story has little significance in terms of modern freight-car construction for general use in coal service.

The Illinois Central now has under construction 400 modern all-welded 50-ton hopper cars built of corrosion-resistant high-strength steel, which weigh approximately 34,000 lb. and will carry their full permissible load limit in coal. It will be obvious to any interested reader, because the arithmetic is very simple and can be done mentally, that the difference between the weight of this modern steel car and the aluminum car described would provide an additional weight saving of 3,400 lb., or a figure in excess of the saving between the aluminum car and a conventional riveted carbon-steel car of recent design.

The load carrying capacity of the aluminum car is not given, but if "on a loaded basis the saving in weight per car will equal about one-tenth of the pay load such a car can carry," it would seem that provision was not made to carry the extra load possible due to the weight saving effected. According to this statement the car has a load capacity of only 10 times the weight saving of 9,900 lb. provided by the use of aluminum, or a total capacity of approximately 100,000 lb., thus falling short by approximately 15 tons of its permissible carrying capacity. However, contrary to the statement quoted above, the overall dimensions given for the reconstructed car indicate that it has a cubical capacity nearly adequate to carry the maximum load limit in coal.

The writer will make no attempt to estimate the added cost of the aluminum car over a similar design of corrosion-resistant high-strength steel. But the minimum excess cost of aluminum over high-strength steel in a 70-ton hopper car, weighing only slightly more than the aluminum car under consideration, was approximately $2,000 per car, and this figure did not take into account the difference in the cost of a load-compensating brake over that of the AB brake.

The producers of all modern materials now available to the designing engineer—aluminum, stainless steel, low-alloy high-strength steel, and no doubt some of the plastic materials—have a deep interest in the modern lightweight or weight-saving development in transportation. It is hoped that any special pleadings for particular materials will be based upon comparisons of modern designs employing these different materials and will thereby provide factual data upon which intelligent decisions may be reached by prospective users.

F. D. FOOTE,
President Alloys Development Company

SPECIAL FITTINGS FACILITATE BRAKE-PIPE REPAIRS.—In a circular letter dated February 12, the secretary of the A.A.R. Mechanical Division called attention to new Item 100, added in Interchange Rule 101, effective January 1, 1948, which is preceded by a note reading: "Note.—Air Brake Pipes of AB brake equipment broken at threaded portion of the flange fitting may be repaired by the use of Wabcogrip or Flexigrip fittings (or other A.A.R. approved types), as correct repairs, charge to be based on material applied, plus labor of application."

LOUISVILLE & NASHVILLE TO SPEND $1,373,300 FOR AB BRAKES IN 1948—The shop forces of the Louisville & Nashville are scheduled to equip 5,000 of the road's freight cars with "AB" brakes this year at an estimated cost of $1,373,300. In addition, the L. & N. plans to convert 150 box cars into pulpwood cars by removing the entire superstructure except steel ends, replacing flooring with a heavier floor and bolting scrap rail to the floor on both sides of the car. This conversion will cost $109,738. The road also will equip 120 locomotives with smoke abatement devices.

C. of Ga.'s Diesel Shop

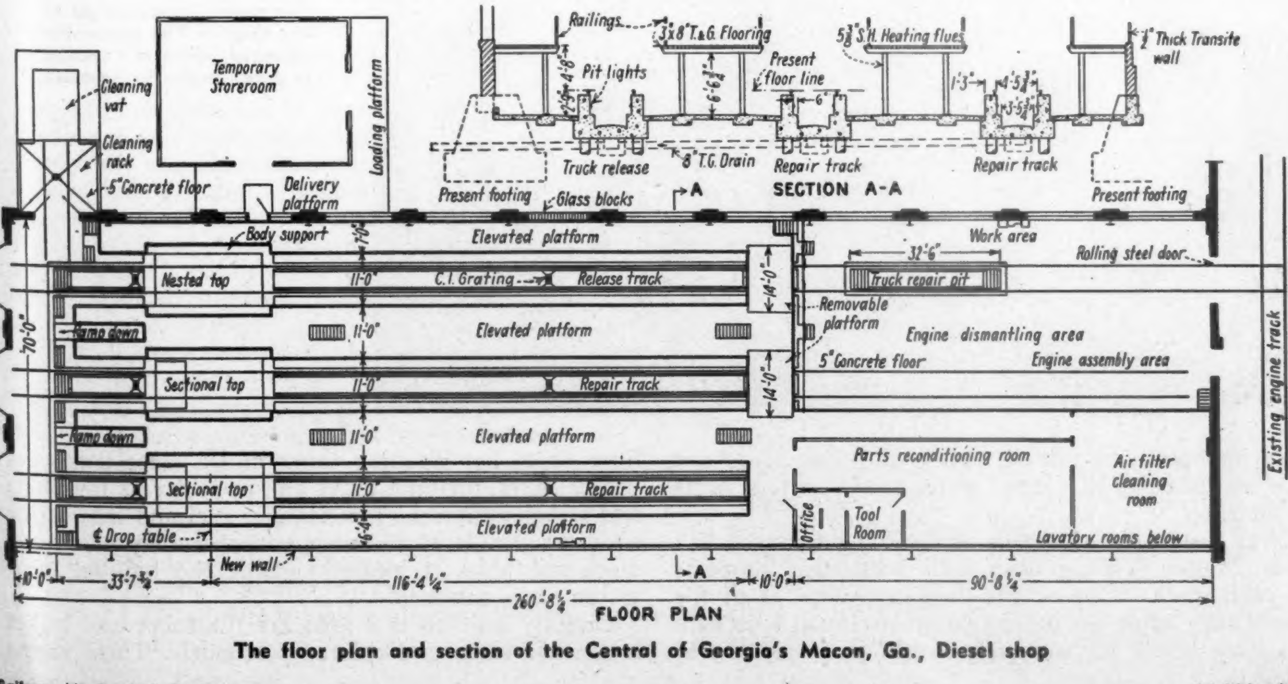
A portion of the backshop at Macon, Ga., is converted into an up-to-date facility for maintenance and repair of all types of Diesel power

THE Central of Georgia has converted a portion of its backshop at Macon, Georgia, into a Diesel shop to handle running maintenance and all classes of repairs to its 22 Diesel switchers, eight 2,000-hp. passenger units and four 1,500-hp. freight units. The switchers include four 600-hp., three 660-hp. and fifteen 1,000-hp. locomotives.

The Diesel shop was constructed in a corner of the backshop, 70 ft. by approximately 261 ft., formerly occupied by the boiler shop. Outside the shop structure the Diesel facilities include a storeroom for spare parts, storage tanks for new, used and reclaimed lubricating oil with pumps and piping to handle the oil directly into and out of the shop, and a cleaning vat for parts to be reused. Sanding and fueling stations are also located adjacent to the shop. However, new fueling facilities are now under construction. Two 250,000-gal. tanks have been installed with the provision made for the future addition of another tank of the same capacity. The fuel oil will be pumped from tank cars using top unloading, metered, filtered and then delivered to the storage tanks. Three tank car stations are being installed at the unloading rack with the layout designed to take care of two more cars to meet possible future requirements. The fuel oil will be filtered and metered again before it is delivered to the locomotives. At the dispensing point three stations will be located between two tracks.

Several changes were made in the main shop building before actual construction of the Diesel facilities could be started. This part of the shop had four tracks for tender and truck work and contained the heavy boiler machinery. The machinery was removed to an adjacent area and relocated without any interference in the boiler repair schedule. The entrance to the shop was altered to accommodate three tracks instead of the original four and an opening was made in the side wall for access to the cleaning vat. The floor of 5-in. concrete topped with 2-in. wood blocks was removed from the entire area.

The accompanying floor plan shows the layout of the shop. Two of the tracks extend the entire length of the shop while the third is a stub track. Elevated platforms flush with the locomotive floor level are built in between and around that part of the trackage with inspection pits. Removable platform sections at the ends of the inspection pits nearest the engine dismantling area permit locomotives on the two longer tracks to be moved to the dismantling area. In addition, because the floor level around the pits is depressed 2 ft. 9 in. below the top of the rails the track sections between the pits and the dismantling area, which is at track level, are on hinged beams. When the beams



The floor plan and section of the Central of Georgia's Macon, Ga., Diesel shop

are swung open the arrangement permits personnel to pass around this end of the pits without climbing over the tracks; when closed the track sections on the beams bridge the gaps between the rail ends.

The pits are four feet deep from the top of the rail. They have 6-in. parapets two feet above the bottom running the entire length along each side. Planking placed on the parapets give added working height for reaching parts on the underside of the locomotive. Recessed lighting fixtures with reflectors set at an angle are located on 8-ft. centers in the side walls of all the pits. Outlets are installed at frequent intervals for supplying current to power tools and extension lights. Vapor-proof fixtures are used in the inspection pits and at the locations where a fire hazard might exist.

Servicing Arrangements

Pipe lines with service outlets for clean lubricating oil, used lubricating oil, compressed air and hot and cold water are suspended from the underside of the platforms. The pipe lines are painted different colors for identification. The lubricating oils are sorted in three tanks just outside the shop entrance. A 15,000-gal. tank contains new oil; another 15,000-gal. tank is used for storing reclaimed oil and the third tank holds the used oil before reclaiming. Two pumps of 60 gal. per min. capacity, located in a pump house adjacent to the tanks, are used to force new oil and reclaimed oil into the shop. The pump for handling the used oil from the Diesel engine to the tank is installed inside the shop.

Temperature control of the water supplied to the locomotives is obtained by connecting the hot and cold water pipes together at the inlet to the shop, regulating the temperature by mixing valves and then using one pipe line to carry the mixed water to the various parts of the shop.

Near the pit ends next to the building entrance is a 23-ft., 90-ton Whiting drop table with body supports on each track. One of the drop-table tops is of the nested type while the other two are sectional tops with auxiliary heads for dropping single pairs of wheels.

The nested top of the 90-ton drop table on the truck release track

A Niles 30-ton overhead traveling crane serves the entire shop area.

The parts reconditioning room, air filter cleaning room, tool room and office are at platform level and occupy a space approximately 28 ft. by 88 ft. The filter room has cleaning tanks and a rinse booth for engine parts, washing tanks and oven dryers for filters and steam equipment for cleaning fuel and lubricating oil cases. A large cleaning vat served by a two-ton mono-rail hoist is located outside the building next to the shop entrance.

Directly beneath this area are the toilet and locker rooms for white and colored personnel. These rooms

The center inspection pit of the shop — The removable elevated-platform section is shown in the background

are equipped with showers, toilet facilities, metal clothes lockers and a Bradley circular basin in each room.

For artificial lighting over the general area four rows of 36 fluorescent fixtures each are mounted overhead. Two 100-watt tubes are used in each fixture. The area under the platforms is illuminated by 50 fluorescent light fixtures, each with two 40-watt tubes.

The shop is heated by four Wing revolving heaters mounted above the bottom members of the roof trusses. Two of the heaters have a capacity of 881,000 B.t.u. per hour each, while the other two have a capacity of 682,000 B.t.u. per hour. Steam at a pressure of 50 lb. per sq. in. is supplied to the heaters.

Fire protection equipment is located throughout the entire shop. There are ten 2-in. standpipes with 50 ft. of 1½-in. hose in the shop, five installed at platform level and five at the depressed-floor level. In addition, 2 CO-Two and 17 Fomene extinguishers are placed at covenient locations.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Bending Wrought Iron

Q.—When rolling wrought-iron plates we have found that with the same thickness of plate we are unable to obtain the same minimum radius in all cases. What determines the minimum radius to which wrought-iron plate can be bent?—F.E.B.

A.—Wrought iron has directional properties, i.e., the ultimate strength and ductility are greater in the longitudinal or rolling direction than in the direction transverse to rolling. This characteristic of the metal is due to the presence of the slag fibers and in plate bending operations it has a direct influence on the limiting radius of bend in the two directions. In other words, the slag fibers in wrought iron affect its bendability and the same wrought iron plate can be bent to a shorter radius when the line or axis of the bend is at right angles to the direction of the slag fibers than when the bend line is parallel to the fiber direction. Ductility is the most important property of the material from the standpoint of bendability. With standard wrought-iron plates the minimum ductility in the transverse direction is 2 per cent in 8 in., while in the longitudinal direction the minimum ductility is 14 per cent in 8 in.

The following formula has been derived from calculating the recommended radii to which wrought-iron plates of various thicknesses can be bent in the two directions. This formula provides an ample factor or safety.

$$R = \frac{62\,T}{S} - .38\,T$$

Where

R = Minimum radius of bend in inches
T = Thickness of plate in inches
S = Per cent elongation in 8 in.

Using a ¼-in. plate having a minimum ductility in the transverse direction of 2 per cent in 8 in. and in the longitudinal direction of 14 per cent the minimum radius for bending the plate with the bend line parallel to the rolling direction is:

$$R = \frac{62 \times .25}{2} - .38 \times .25$$

$$R = 7.75 - .095 = 7.665 \text{ or } 7\tfrac{5}{8} \text{ in.}$$

The minimum radius for bending the plate at right angles to the direction of rolling, is:

$$R = \frac{62 \times .25}{14} - .38 \times .25$$

$$R = 1.107 - .095 = 1.012 \text{ or } 1 \text{ in.}$$

Swaging Practice

Q.—In maintaining tubes in the rear tube sheet of our locomotive boilers, it is our practice to increase the thickness of the copper ferrule to compensate for the enlargement of the hole in the tube sheet. When applying new tubes to old tube sheets would it not be satisfactory to maintain a standard thickness of ferrule for new tube applications and swage the new tubes to suit the diameter of the ferrule opening in the tube sheet?

A.—Increasing the thickness of the ferrule to compensate for the enlargement of the hole in the tube sheet would be the practical method of maintaining the tubes in the rear tube sheet. The general practice is to vary the thickness of the ferrule to compensate for the enlargement of the tube hole up to ⅛ in. or over. The tube end is swagged ⅛ in. larger in diameter, using the minimum thickness of ferrule and increasing the thickness of the ferrule to compensate for any additional enlargement of the hole until the condemning limit it reached. It is easier to stock the various sizes of ferrules than it would be to stock or furnish tubes with various diameters of swaged ends.

Swaging Practice for 2-in. Tubes

Diameter of tube, in. Nominal	Diameter of tube, in. Swaged end	Diameter of hole, in.	Ferrules Outside diameter, in.	Ferrules Gage, B.W.G.	Ferrules Thickness, in.	When used
2	1 47/64	1 7/8	1 7/8	15	.072	New work
2	1 47/64	1 29/32	1 29/32	14	.083	Maintenance
2	1 47/64	1 59/64	1 59/64	13	.095	Maintenance
2	1 47/64	1 61/64	1 61/64	12	.109	Maintenance
2	1 55/64	2	2	15	.072	Maintenance

Draft-Plate Air Proportion

Q.—The Master Mechanic's front end is used on our Mikado-type locomotives, which are about twenty years old. During that time they have been modernized by the addition of a feed-water heater, multiple throttle, and Type-E superheater. I would like to check the front end, especially the draft-plate adjustment. What is the correct proportion of air at the draft plate?—K. L. J.

A.—While different-type locomotives and different fuel might call for various alterations and adjustments of the several units in the Master Mechanic's front end, a fairly safe basis for efficient drafting is to use the open area of the tubes and flues less the superheater unit area as a 100 per cent base, and reduce this area to 75 per cent (preferred) at the adjustable draft plate in the front end, with permissible limits of 65 to 80 per cent.

In the event the locomotive is equipped with a brick arch, leave provision at the top of the brick for 115 per cent open area so that restriction will not cause pulling or tearing up of the fire. The open area in the front-end netting or spark arrestor should be 130 per cent (preferred) with permissible limits of 110 to 140 per cent to allow an even flow of the gases and heat from the firebox to the stack and out to the atmosphere.

The Causes and Effects of

Low Compressed-Air Pressure*

Some important points on how to keep the shop's compressed air installation operating to increase production capacity

Low air pressure is a costly and wasteful practice which should not be tolerated. Ignorance of the effects of low air pressure contributes more than any other single factor to a lack of appreciation of the effectiveness of compressed air power.

By "low air pressure" is meant inadequate pressure at the tool or the device which is air-operated. It is at this point that the air is used as power. Only the pressure and volume of air available at the point of use can be effective in doing work. Most pneumatic tools, for example, are designed to operate at 90 lb. per sq. in. gauge maximum at the tool. This means pressure at the point where the air enters the tool while the tool is operating. If the pressure is below the range of 85 to 90 pounds gauge, then it should be considered too low since it reduces the ability of the tool to do the maximum work for which it was designed.

The causes of low air pressure are easily classified as follows: (1)—Insufficient compressor capacity; (2)—Inadequate piping, and (3)—Leakage.

When it is discovered that pressure is too low, the first inclination is to install more compressor capacity. That is not necessarily the correct answer. It should first be determined whether the compressors are at full load when the air pressure is low. If they are, then more compressor capacity may be required but, even then, consideration must first be given to the two other common causes of low air pressure.

Operating Data of Compressed-Air Installation

Operating air pressure at compressor, lb. per sq. in.	100	100
Operating air pressure at tools, lb. per sq. in.	70	90
Tool load factor, per cent	33	33
C.F.M. required per tool at maximum load	50	68
Number of men and tools	20	20
Total C.F.M. used	333	453
Total cu. ft. used per 8-hr. day	160,000	217,600
Cost of air per 1,000 cu. ft., dollars	.05	.05
Cost of air per day, dollars	8.00	10.88
Increased air cost, dollars	....	2.88
Labor rate per 8-hr. day (incl. burden), dollars	16.00	16.00
Total labor cost per day, dollars	320.00	320.00
Total cost per day, dollars	328.00	330.88
Ratio of air cost to total cost, per cent	2.4	3.3

The second cause is "inadequate piping". A measure of the adequacy of piping is the pressure loss between the air receiver, where the compressor endeavors to maintain a constant pressure, and the point of use. This should not exceed 10 per cent in a well designed system. The absolute maximum drop for the worst point in the system should not exceed 15 per cent. If the pressure drop is greater than 10 per cent average or 15 per cent maximum throughout the entire distribution system (including hose), then attention should be given to correction of this fault before considering increased compressor capacity.

A third cause of low air pressure is leakage or loss of air without doing work. It has been pointed out that permitting excessive leakage is the same as exhausting the output of a compressor directly to atmosphere. Obviously, if leakage is eliminated, the compressed air formerly wasted will be aavilable for useful work. The expense of making lines tight will undoubtedly be less than the installed cost of a new compressor, while the daily power saving may be considerable. The gas industry considers a loss of more than one cubic foot per minute per *mile* of three-in. line as excessive.

Elimination of leakage is certainly a sensible step toward maintaining air pressure and conserving power.

There are very few uses of compressed air not vitally influenced by low air pressure. All portable pneumatic tools, rock drills, concrete breakers, hoists, scrapers, loaders, all pneumatic transfer and conveyor systems, paint sprays, oil burners, sandblasts, air lift pumps, etc., operate less effectively when the proper air pressure is not maintained.

The positive result of increasing air pressure to the proper value is increased production and reduced cost per unit produced. The economic advantages of increased air pressure (or conversely, the losses due to low pressure), can be nicely illustrated by considering portable pneumatic tools. For example, an average increase of 37 per cent in production can be obtained for about a 30 per cent increase in air consumption by increasing the air pressure at the tools from 70 pounds to 90 pounds.

Consider an installation of 20 tools operating from an $8,500.00 compressor plant, first at 70 lb. per sq. in. and then at 90 lb. per sq. in., pertinent data for which are given in the accompanying table. With power at one cent per kilowatt-hour, fixed charges at 15 per cent of installed cost, plus labor and supplies, air at 100 lb. per sq. in. pressure costs five cents per 1,000 cu. ft. Assuming that only one-third of the 37 per cent increase in tool productivity can be translated into labor productivity, it is evident that 12 per cent more actual work will be accomplished with 90 lb. per sq. in. air pressure than with 70 lb. per sq. in. air pressure. The work previously done for $328.00 can now be done in less time and will reduce the cost to $330.88 divided by 1.12, or $294.71. Thus, even though air costs are increased, there is a net saving of $33.29 per day, or about $8,500.00 per year (equal to the first cost of the compressor plant).

Analyzing this another way, when the pressure is increased to 90 lb. per sq. in. the tools require 120 cu. ft. per min. more air. A compressor with motor and auxiliary equipment to supply about this amount of air would cost $2,200.00. The saving of $33.29 per day would pay for this new unit in 68 working days, less than three months.

When the question arises of purchasing additional compressor capacity as opposed to making other arrangements for the operations involved in a shop, it should be remembered that adding to compressor-plant capacity frequently affords protection for many vital shop operations other than the operation of pneumatic

*Based on material contained in the new "Compressed Air Handbook," published by the Compressed Air and Gas Institute.

tools. Among these are sandblasting, paint spraying, hoisting, agitation of liquids, air jet vacuum equipment for cleaning foundry sand, operating controls in power plants, air chucks in a machine shop, safety devices on punch presses, air jets for ejecting parts from presses, etc.

The remedies for low air pressure are just as definite as the causes and effects.

Faulty air-power conditions are usually due to poor planning or to increased air uses without corresponding system expansion. Plant-wide analysis should determine the full extent of low air pressure and the present air flow requirements. Future growth must also be considered.

Pressure loss varies roughly as the square of the velocity of air flowing through the pipe. For example, a 3-inch line, 1,000 feet long, will handle 500 cu. ft. per min. with a 2.5-pound pressure loss, while a 4-inch line will pass about 1,000 cu. ft. per min. with the same drop. The *installed* cost of the 4-inch line will, however, be very little more than that of the 3-inch line, since most of the cost is labor.

Methods of increasing pipe-line capacity to decrease pressure loss and improve conditions at the point of use vary with different installations. One may call for a line paralleling the original, with frequent interconnections; another may require installation of a loop system with some outlets taken off the new line to relieve the old; still another may need a complete new system. Branch lines and manifolds for attachment of tools, etc., should be planned "oversize."

Not the least of the problems of correct system layout is the selection of proper hose for final transmission of compressed air to the tool. Losses of 15 per cent to 25 per cent in air pressure are frequent in the hose alone. *Don't* use a hose longer than is necessary to make the tool available to the work and to give proper freedom of movement to the operator.

Every cubic foot of leakage eliminated is pure gain. Such losses in many systems will reach 10 per cent to 20 per cent of the total air compressed. An air leakage test should be run on the complete plant and every section of hose should be inspected. Although leaks are unusually small, they may be numerous, having a high total effect. A single 1/16-inch hole will waste 182,000 cu. ft. per month, costing $9.10.

The most likely locations of small leaks is around valve stems, in hose connections, unions, drains, home-made blow guns, and lines leading to inoperative tools. Elimination of leakage involves making the system tight, then keeping it tight. Regular inspection is mandatory. Only after it has been determined that the distribution system is adequate and that leakage has been eliminated, should increase in compressor capacity be considered.

Air Brake Questions and Answers

The 24 RL Brake Equipment for Diesel-Electric Locomotives—Parts of the Equipment—Locomotive A Unit

D-24—Control Valve (continued)

642—*Q.—What is the purpose of the high pressure valve?* A.—To connect emergency reservoir air to the displacement reservoir during emergency applications.

643—*Q. What are the functions of the spill-over and ball check valves?* A.—To provide against overcharge of the quick action chamber.

644—*Q.—What do the accelerated release and ball check valves do?* A.—They provide the accelerated build-up of brake pipe pressure (after emergency) from the combined volumes of the auxiliary reservoir and the displacement reservoir when the slide valve moves to accelerated release position.

645—*Q.—What is the purpose of the diaphragm spring and slide valve strut?* A.—They serve to keep the slide valve seated in the absence of quick action chamber pressure.

646—*Q.—What pressure does the safety valve limit?* A.—It limits the displacement reservoir pressure.

647—*Q.—When is this in effect?* A.—During service brake applications.

648—*Q.—What pressure is the safety valve set to open at?* A.—75 lb. approximately.

649—*Q.—How is the service brake cylinder limited to approximately this amount?* A.—This is due to the fact that the displacement reservoir pressure determines that supplied to the brake cylinders.

650—*Q.—What is the purpose of the charging choke plug?* A.—To control the rate of flow from the brake pipe to the quick action chamber.

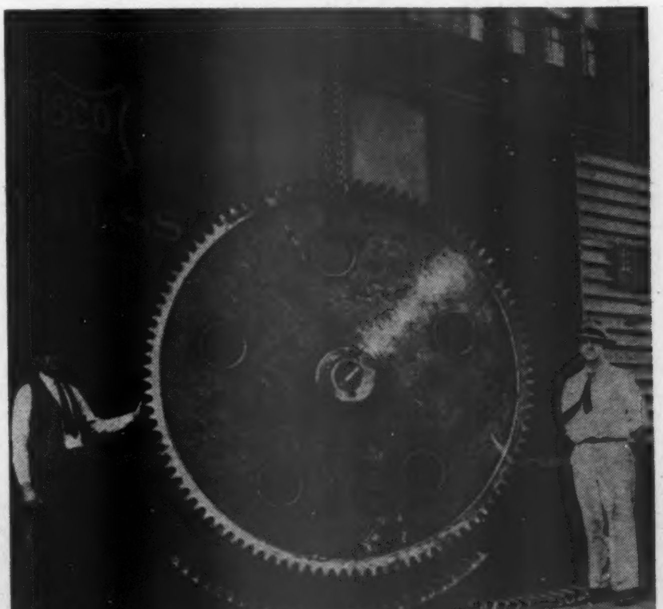
651—*Q.—Is there any possibility of this choke being restricted due to fine dust?* A.—This is guarded against by the use of a felt strainer.

652—*Q.—What chokes control the rate of exhaust of quick action chamber air during emergency applications?* A.—The choke in vent piston and in the vent valve cylinder cover.

653—*Q.—What does this controlled rate provide for?* A.—Provides the time interval required before release can be effected following an emergency application.

Fast Replacement Saves Heavy Demurrage

When a huge broken gear wheel is holding up 2,000 cars that are running up demurrage at the rate of $3,000



The 8-ft. tipple gear wheel fabricated at the West Springfield shops of the Frisco

How the gear teeth were cut using an Oxweld flame-cutting machine and nozzle

a day, something must be done to effect replacement or repairs with the least possible delay. That's the situation recently faced by the St. Louis-San Francisco when a gear wheel 8 ft. in diameter in the coal tipple at Pensacola, Fla., failed with a yard filled with coal cars waiting to be dumped.

Since the old gear was damaged beyond repairs, it was decided to construct a new one at the Frisco shops, West Springfield, Mo. The rim of this shop-fabricated replacement gear wheel was made from four forged segments welded together in a circle. This rim was next bored out to a depth of 1½ in. on both sides. Two solid circles of ½-in. boiler plate were flame-cut to fit into the recesses on the rim. Five 10-in. sleeve holes were also flame-cut in the boiler plates which were welded to both sides of the rim. The hub and five 10-in. sleeves next were welded in and the piece was ready for flame-cutting the 101 gear teeth.

At the flame-cutting station, a 1-in. piece of boiler plate with a center bushing was welded to the cutting machine. The hub of the wheel was placed over the bushing and three jacks were set under the outside of the wheel to help support and level it. It was necessary to make two settings of the wheel as the Oxweld flame-cutting machine could handle only one-half of the wheel at one time.

With an Oxweld No. 12 Series-1502 nozzle, the cutting speed was 4 in. per min. through the 10-in. thick steel. The cutting blowpipe was set 90 deg. with the face of the wheel and the cut started on the first tooth from the outside with a lead-in attachment which is part of the cutting machine. Teeth were cut to finish size and only about 25 teeth required machining. This small amount of machining was necessary because of the expansion crawling of the rim from the heat of the blowpipe. There were 606 in. of cutting, and actual cutting time was 2 hr. 20 min.

A smaller but not unimportant part of the job was the fabrication of a smaller gear with 25 teeth to replace a similar gear that broke with the larger gear. The small gear was cut from a solid billet.

Now that the broken gears are replaced, the shop is making repairs of the older gears which will be kept on hand as spares. Four days from the time the general office was notified of the broken gears, the new gears were on the way by special train from the West Springfield shops.

Questions and Answers On Locomotive Practice

By George M. Davies

(This column will answer the questions of our readers on any phase of locomotive construction, shop repairs, or terminal handling, except those pertaining to the boiler. Questions should bear the name and address of the writer, whose identity will not be disclosed without permission to do so.)

Smokebox Braces

Q.—Why are smokebox braces eliminated from modern locomotives?—I. M. F.

A.—The smokebox brace was primarily used on the older locomotives to support the front rail section of the engine frame. On modern power using cast-steel engine beds with integral cylinders the front section of the engine bed has ample strength.

Advantages of Multiple-Bearing Crosshead

Q.—What are the advantages of the Laird or multiple-bearing crosshead over the conventional alligator crosshead?—E. L. M.

A.—The advantages claimed for the Laird or multiple-bearing crosshead are: (1) Considerable crosshead weight can be saved, thus reducing the amount of reciprocating weight to be balanced; (2) the multiple-bearing crosshead requires only one guide, which is located about the same height above the rail as the top guide of the alligator type assembly, thus eliminating the trouble experienced due to dirt and foreign matter collecting on the lower guide; (3) more positive lubrication, as one guide receives oil direct from the lubricator. On locomotives equipped with the alligator type crosshead the lower guide generally receives its oil from the top guide, and (4) removing the main rod from the crosshead is simplified with the multiple-bearing crosshead because there is no lower guide.

Water-Glass Drain Pipes

Q.—Do the I.C.C. rules provide that the water-glass drain pipes shall not be run through the deck?—J. M. L.

A.—The Laws, Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders, and other than Steam Locomotives, as prescribed by the I.C.C. Bureau of Locomotive Inspection do not specifically state that the water-glass drain pipes should not run through the cab deck. The water column arrangement for water glass and gauge cocks as recommended by the Bureau of Locomotive Inspection and adpoted by the Association of American Railroads in 1920 provides that the water-glass drain and escape pipes should extend down to one-inch above the floor or deck, discharging through larger holes in the floor or deck, with an alternate arrangement of having a funnel arrangement in the cab floor with the end of the drain and escape pipes directed into the funnel. With either arrangement the end of the escape and drain pipes should be visable to the engine crew to warn them of a broken water glass. This, then, becomes a safety measure and would be covered by the law in that all locomotives must be safe and suitable for service in all respects.

With the Car Foremen and Inspectors

Painting Passenger Cars

SEVERAL primary objectives in passenger car repainting are obtained by the methods employed and the facilities installed at the Chicago, Rock Island & Pacific's 49th-street car shop, Chicago. The adoption of spraying as the standard method of paint application has made the task of keeping cars clean between shoppings appreciably easier because of the superior finish that results from the absence of brush marks. At the same time the potential painting capacity of the shops has been approximately doubled and the shopping time of a car reduced as a result of two combination spraying and drying booths, which have lessened the time required for the application and drying of both interior and exterior paint. The ventilation system in the combination spraying and drying facilities contributes to the attainment of a smoother application of paint by reducing dust and over spray and permits up to three workmen to spray simultaneously inside a passenger car.

The complete renovating job begins in the regular coach shop with the cleaning of the dirty waxed paint in the car interior. The cleaning is done with a solution made by adding four ounces of soap and one pint of naphtha to a gallon of water. This combination is satisfactory for cutting the wax and, at the same time, the proportion of naphtha is not large enough to be explosive. After the areas to be painted are thoroughly cleaned, the plaster is hand sanded to a super-smooth finish as a preliminary preparation for spraying. Great care is taken to give the plaster an exceptionally fine finish as it is this high degree of finish, plus the absence of brush marks, that contributes materially to easing the job of keeping the car clean in service by eliminating, in so far as possible, places for dirt to lie in and cling to.

The areaway between the two combination spraying and drying booths showing the lighting arrangement and the counterweights for the electrically operated scaffold-elevators

A booth in the paint shop looking toward the Hydro-Filter units

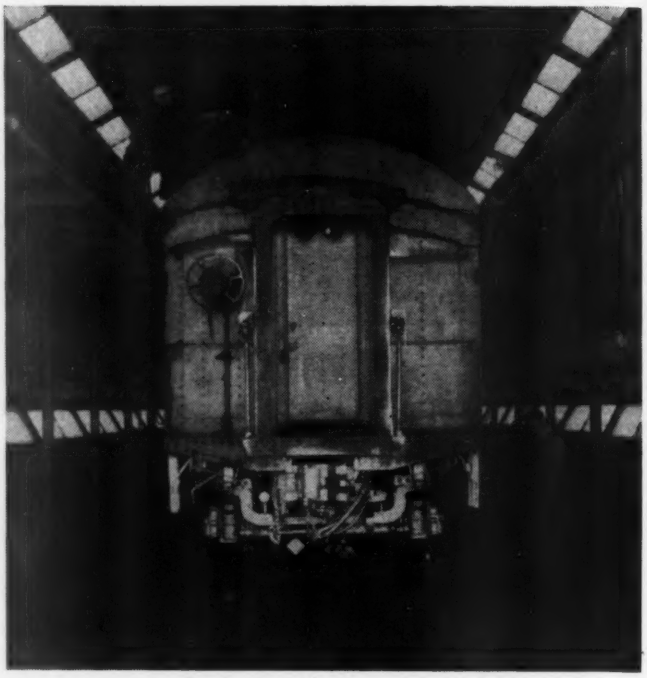
The exterior paint is removed either in the regular coach shop or in one of the combination spraying and drying booths depending on the type of paint. Oil paint is removed with compound in the regular coach shop while lacquer paint is removed with varnish remover in the paint shop. After all the paint that is to be removed in the regular coach shop is removed, the interior finished by hand sanding and masked, and the exterior by electric or air sanders, the car is moved into one of the painting and drying booths. After the car enters the booth at the front, a steel overhead rolling door is lowered into place to seal off the enclosure. When spraying is ready to begin, the ventilation system is turned on, and the work proceeds from front to rear to follow the flow of the ventilating air.

The paint shop itself comprises two combination spraying and drying booths furnished by the R. C. Mahon Company, Detroit, Mich. Each is supplied with clean filtered air, is equipped with thermostatic control for maintaining the desired temperature for painting or dry-

ing, and contains filtering units for removing the paint particles from the air before discharge to the atmosphere. Illumination is furnished by two rows of explosion-proof fluorescent lights on each side of each booth, one row about five foot above the floor and the other row where the side wall meets the ceiling.

Clean filtered air enters the booth through diffusers in the ceiling at the front end and flows toward the rear where two batteries of filtering units known as Hydro-Filters remove paint particles from the air before it exhausts to the atmosphere. The Hydro-Filters remove the excess paint particles from the paint-laden air as it passes through a spray containing a mixture of water and a special compound which coagulates the paint upon contact. After coagulation, the paint is carried by the water to a settling tank where it collects on the surface and is later removed. During the spraying operation a temperature of 70 deg. F. and a pressure slightly above atmospheric is maintained in the booth, and the ventilation and circulation system kept in operation.

All levels of the car exterior can be sprayed easily, as well as different levels sprayed simultaneously without interference, because of the novel scaffolding arrangement. The scaffolds are of the elevator type, electrically controlled, and extend the length of the enclosure, one on each side of the car or locomotive to be painted. The platform on which the workman stands is supported, raised and lowered on sets of small wheels which ride in vertically mounted I-beams set against the side walls of the booth. This platform is made of expanded metal which presents a non-skid surface and enables the workmen to see through the platform for raising and lowering it. The method of supporting and elevating the scaffold offers a completely unobstructed working area beneath the scaffold. Work, therefore, can proceed on at least two different levels on any one side of the car at the same time because the platform for the upper-level workmen is raised so that it does not interfere with the men standing on the floor and working on the lower part of the car. The scaffolding platform may be moved from any point along its length. There are two cables which extend from end to end; pulling one cable raises the platform while pulling the other cable lowers it. Safety switches prevent the platform from going either too high or too low.



The arrangement of the scaffolding in the Mahon finishing system permits work to be done at several different levels simultaneously without job interference—Here the roof is being sprayed by the man on the left, the upper half of the right side painted by men on the right scaffold, while at the same time the men working on the lower part of the right side of the car have no obstruction from the scaffolding

The Hydro-Filter units at the rear of one of the combination spraying and drying booths remove all over-spray from the air before it is exhausted from the enclosure

When the painting operations are completed the Hydro-Filter units and the filtered air supply are shut off. The recirculating system is left in operation, and the heating controls are turned on to warm the enclosure to a suitable temperature for drying the particular finish applied.

The shop forces have added an innovation to the sewerage system that has proved highly effective in preventing clogged drains and flooded floors. To catch the paint which has been scraped off, ¼-in. holes have been drilled in the sloping side of a receptacle shaped like a five-gallon milk can just below the neck. A funnel, the top of which is flanged to rest in the drain opening, extends into the neck of the receptacle. When the paint paste is washed from the floor, the mixture of water and paste flows through the funnel and drops to the bottom of the receptacle. As the receptacle fills, the water begins to flow out the ¼-in. holes, leaving the paint paste in the bottom. Periodically, the receptacle, which rests on a ledge in the drain, is removed and cleaned.

Approved Side Frame And Bolster Designs

In discussing regulations governing applications for approval of side frame and bolster designs, the A. A. R. Mechanical Division states in a circular letter dated February 28 that considerable misunderstanding on the part

of many railroads as well as manufacturers has existed for several years regarding A. A. R. requirements for truck side frames and bolsters for freight cars. This was probably due to the fact that in order to ascertain what all of the requirements were it was necessary to consult not only the Interchange Rules and the Manual, but various D. V. Circulars.

Last year this situation was clarified by a revision in A. A. R. Specifications M-203 and M-202 covering side frames and bolsters, respectively, incorporating for the first time in these specifications all of the essential requirements. These revised specifications were submitted to letter ballot and received unanimous approval.

There still remained the necessity of formulating a set of regulations to simplify and systematize as much as possible the procedure for handling applications for approval. With this object in view, a joint meeting was held on November 21, 1947, in Chicago by the A. A. R. Joint Subcommittee on Side Frames and Bolsters and representatives of all the leading manufacturers.

At this meeting the revised regulations were unanimously agreed upon and, since that time, a few minor modifications have been requested by the manufacturers and approved by the Joint Subcommittee, being included in the following regulations.

A. A. R. Regulations Governing Applications For Approval Of Side Frame and Bolster Designs*

Side Frames

All designs that have been approved and listed in A. A. R. Circular D. V. 1108 and subsequent annual reports of the Car Construction Committee are to be considered approved and exempt from further submission to the A. A. R. Joint Subcommittee.

All base pattern designs not already approved shall be submitted to the A. A. R. Joint Subcommittee on Side Frames and Bolsters through the Secretary of the Mechanical Division, for approval or advice that official A. A. R. static and dynamic tests are required.

Approval of a design applies only to the manufacturer for whom it is approved; it does not cover an identical or similar design made by another manufacturer or the same design made of a different material by the same manufacturer. However, a design already approved for one manufacturer may be approved for another manufacturer without dynamic fatigue tests provided the manufacturer seeking approval has accumulated a satisfactory record of having fully met dynamic test requirements in the past. To be "satisfactory" this record must cover at least ten different designs and approximately forty specimens of side frames, produced by such manufacturer, which have been submitted to dynamic fatigue tests under the supervision of the A. A. R. or a member road.

When a base pattern design has been approved, such approval will also apply to any issues of that pattern when any of the following changes are made:

Brake-hanger bracket (location and type), or removal of brake hanger bracket.

Addition or removal of "Creco" fourth-point support bracket.

Addition or removal of tie-rod bracket.

Addition or removal of Unit brake-beam guide bracket.

Addition or removal of brake-beam safety ledges.

Addition or removal of journal-box waste-retaining ribs.

Location, omission, or addition of spring or spring-plank bosses, provided bending moment at center of frame spring seat is not increased.

Change in journal-box hinge lug design.

Addition or removal of pad used for stamping truck number.

Columns altered to make any of the following designs current as of November 21, 1947, provided there is no increase in width of the bolster opening at the bottom:

Conventional, Barber S-2, A-3 Ride Control, Double-Truss Self-Aligning Spring-Plankless, Double-Truss with Spring Plank, Snub-Up and Basic.

Bolsters

All designs that have been approved and listed in A. A. R. Circular D.V. 1108 and subsequent annual reports of the Car Construction Committee are to be considered approved and exempt from further submission to the A. A. R. Joint Subcommittee on Side Frames and Bolsters.

All base designs not already approved shall be submitted to the A. A. R. Joint Subcommittee on Side Frames and Bolsters, through the Secretary of the Mechanical Division, for approval or advice that official A. A. R. static tests are required.

When a base pattern design has been approved, such approval will also apply to any issues of that pattern when any of the following changes are made:

Style of the end of the casting within the spring seat-area where no reduction is made in the strength of critical sections.

Style and location of dead-lever bracket or omission of same.

Addition or removal of single or double brake-beam safety-guard brackets.

Addition or removal of single or double Pur-fect brake-beam safety-guard brackets.

Addition or removal of Creco Economy brake-beam safety-guard brackets.

Addition or removal of holes for Buffalo, Grip Nut or Drexel brake-beam safety-guard brackets.

Addition or removal of integral friction or pocket-type side bearings or change in contour of side-bearing pad.

Addition or removal of finish allowances in center plate.

A reduction of ½ in. or less in the distance from the spring or support seat to the center plate bearing surface.

Any increase in the distance from the spring or support seat to the center plate bearing surface.

Change in center-plate contour.

*Under Specifications M-203-47 and M-202-47, respectively.

Ferrule and Thrust Bearing Remover

The thrust bearing and the ferrule used in Vapor steam-line connections between cars are removed with little time and effort and with no damage to the bearing or ferrule in a set-up developed by the shop forces at the Chicago, Rock Island & Pacific's Forty-ninth street passenger-car shop, Chicago. The fixtures necessary to perform both of these operations are located in an area less than one foot by one-half foot on the edge of a metal bench.

The apparatus for removing ferrules in an undamaged condition comprises two parts, a suitably shaped punch and a Vapor No. 1136 L fitting, the top elbow of which has been sawed off and the remainder of the fitting bolted to the bench. The ferrule inside of the rubber gasket that is renewed at each overhaul is set on the bench fitting, and the ferrule driven through the rubber and the bench fitting by a specially shaped punch. The punch is made so that the first half inch from the bottom fits inside the smallest diameter of the ferrule, which is at the

Ferrule-removing jig, left, and a rubber gasket from which the ferrule has been removed—The punch for driving the ferrule out is resting on its shoulder on top of a ferrule inside a gasket that is in place in the bench fitting for removal of the ferrule—On the right is the hose clamp being held in position by the dowel pin and bench bushing for removal of the thrust bearing

top as the ferrule rests in the bench fitting. At one-half inch from the bottom the punch enlarges to a diameter approximately ⅛ in. larger than the bottom diameter, which provides a 1/16-in. collar or shoulder to catch the top of the ferrule. The 1/16-in. shoulder is sufficient to give a firm bearing contact for driving the ferrule clear of both the rubber gasket and the bench fitting, and at the same time is small enough that the diameter at the largest part of the punch fits easily within the gasket and fitting for driving out the ferrule.

Thrust bearings are removed from Vapor part number 1136 H, the clamp for steam hoses, by a pair of fittings located to the right of the ferrule-remover jig. The hole in the clamp arm is placed over a ½-in. dowel pin which is welded to the work bench. The end of the arm which holds the thrust bearing then fits over a bushing which is welded to the bench. The thrust bearing is removed by driving it out with a punch which contacts the bearing through the hole in the bottom of the opening which retains the thrust bearing. The bench bushing has an inside taper which is larger at the bottom than the top to allow the bushing to fall clear.

Air-Conditioning Maintenance Work*

By R. E. Johnson†

The major requirements of air conditioning consists of (1) cooling, (2) heating, (3) dehumidifying, (4) circulating, (5) cleaning and filtering, (6) humidifying which is also an air-conditioning requirement, but has not been extended to railroad air conditioning due to the resultant fogging and freezing of moisture on windows, obstructing vision.

At the present time, there are five well-known and tested air-conditioning systems, known as electro-mechanical, Pullman mechanical, steam-operated, ice-actuated and gas-powered. Each has been in operation for some time and has proven satisfactory. . . . . .

In three of the mechanical air-conditioning systems mentioned, Freon 12 is used as a cooling medium. Many control devices and accessories are required including a cooling unit or evaporator, expansion valves, blower fan, compressor, condenser, condenser fan, pressure switches, control panel, thermostats, etc.

Each of these units plays an important part and must be thoroughly maintained if proper cooling is to be obtained. The cooling coil or evaporator must be washed periodically to avoid the accumulation of dust and dirt from bridging across the fins, restricting the flow of air and thus reducing the cooling capacity of the system. Undesirable odors are also soon noticeable in cars where evaporators are not washed periodically.

Expansion valves should be inspected periodically and their thermal element clamped securely. The expansion valve is important and it serves two purposes. The flow of refrigerant liquid into the evaporator is regulated by the expansion valve. This valve also admits liquid refrigerant into the evaporator as required to replenish the refrigerant which has been vaporized and compressed. It also maintains pressure on the ilquid line to the evaporator so as to retain the refrigerant in its liquid state.

Blower-fan motors must be properly maintained, thus eliminating grooved commutators. Brush boxes must be free from oil, and lint, and brushes should work freely in the boxes. Lubricate ball bearings monthly.

Compressors should be kept clean and inspected periodically for leaks at head gaskets. Sufficient oil in the crankcase is important and this can usually be inspected from a sight glass provided for that purpose.

Condensers are an important part of the air-conditioning system. Dirty condensers cause high head pressures and leaky gaskets at the compressor head. They also cause pressure switches to open on high pressure and reduce the cooling capacity.

Condenser fans and condenser-fan motors when used, must be inspected periodically. Failure of the condenser fan would soon cause high head pressures and an air-conditioning failure would result.

An air-conditioning system, made up of all the parts mentioned, is divided into two sections with referenc to pressure, these sections being designated as the high side and the low side. The high side extends from the compressor head, (high side) through the condensers, then into the liquid receiver, through a filter and up to the expansion valve. The low side or suction side extends from the expansion valve through the evaporator and back to the suction side of the compressor. Freon pressure gauges are usually installed in the lines for checking head pressure and suction pressure. These gauges are also used for checking the cut-in and cut-out pressures of the high and low-pressure switch. Whether or not there is sufficient refrigerant in the system can usually be detected by observing the gauge pressure after a system has been cycled or operated on standby for a short period—approximately one hour.

The word "cycle" as applied here means a series of operations in which heat is first imparted to the refrigerant, changing it from a liquid to a vapor, after which the vapor is compressed and forced into the condenser where the heat is absorbed by the cooling medium, thus bringing the refrigerant again to its original or liquid state.

Both fresh-air and recirculating filters are to be dusted each three or four days by removing the filter from its container and either blowing it lightly with compressed air or dropping it to release the loose dust. Recirculating filters, which normally are of the non-washable oiled type, should be watched closely and be renewed as soon as they show the least indication of becoming dry.

Fresh air filters which are generally the metallic type, should be removed and cleaned every two weeks. These

*Excerpts from a paper presented at the March 8 meeting of the Car Foremen's Association of Chicago.
†General electrical foreman, New York, Chicago & St. Louis.

filters are cleaned by boiling in a caustic solution, allowing surplus water to drain off, dipping them into an odorless oil and allowing them to drain in a temperature of approximately 150 deg. until all traces of free oil are removed.

Electronic air filters are being considered for cleaning air in railway air-conditioning systems in preference to other types, due to their ability to remove tobacco and other smoke from the air, as well as their extremely high efficiency in removing the fine dust which causes much of the discoloration of walls and upholstery.

There are several other makes of efficient air filters, such as the Precipitron and the Electro Airmat. Air cleaning by electrostatic devices is probably the most effective means yet developed for all purposes.

The cost, however, of installing electrostatic filters is quite high in comparison with other car accessories, so much so as to make the advisability of installing a unit of this kind questionable.

In the maintenance of air-conditioned cars, it is essential that the car-lighting equipment be closely checked and rigidly maintained. Air conditioning itself depends largely on the condition of the car-lighting equipment.

A generator failure will soon result in a battery failure. A battery failure on most cars means an air-conditioning failure. The lamp regulator also plays an important part in air-conditioning performance. Many relay coils, solenoid coils, thermostats, etc., operate on regulated voltage and the lamp regulator must be properly maintained for good performance of this equipment.

(The extensive and constructive discussion which followed reading of this paper will be abstracted in a subsequent issue of Railway Mechanical Engineer.—Editor)

Periodic Inspection and Tests
Pullman Type

Daily

Check blower fan for noise and volume.
Check magnetic and solenoid heat valves for sticking.
Check current flow through speed control (7½ to 10 amps.).
Check exterior parts for visible defects and oil leaks.
Check for loose quill.
Check V cog-belt connector pins.
Check oil in driven unit.
Operate equipment on standby and check tension on compressor and condenser fan belts.
Check condition of V cog belts.
Check voltage drop of caterpillar (not to exceed 5 volts).

Weekly

Check all listed daily features.
Lubricate driven-unit link-hanger pins.
Lubricate driven-unit support-bar bushings (not rubber type).
Check oil in speed control.
Check V cog-belt tension device.
Blow out recirculating air filters.

Semi-Monthly

Check all listed daily and weekly features.
Clean fresh-air filters.
Check speed-control brush assembly.
Blow out compressor box and condensers.
Lubricate spline on long and short drive shaft.

Monthly

Check all listed daily, weekly and semi-monthly features.
Clean control-panel contacts.
Inspect blower-fan motor and lubricate the bearings.
Inspect and check expansion valves.
Test all thermostat tubes.
Clean pressure switch and check cut-in and cut-out pressures.
Test system for Freon leaks.
Operate system on standby one hour and check height of oil in compressor crank case and height of Freon in receiver tank.
Lubricate drive-shaft universal joints (long and short shaft).
Check for grounds in all electrical circuits.
Clean a.c. starter switch contacts.

Three Months

Check all listed daily, weekly, semi-monthly, and monthly features.
Lubricate standby motor bearings (beginning of cooling season and three months after).
Lubricate condenser-fan bearings.

Start of Cooling Season and Six Months After

Check all listed daily, weekly, semi-monthly, monthly, and three-months features.
Lubricate speed control armature bearings.
Wash evaporator and overhead heat coil (beginning of cooling season only).
Gauge all pulley grooves for wear.

Frigidaire Electro-Mechanical Type

Daily

Check blower fan for noise and volume.
Check magnetic and solenoid heat valve for sticking.
Check exterior parts for visible defects and oil leakage.
Check tension on compressor belts.

Weekly

Check all listed daily features.
Blow out recirculating air filters.

Semi-Monthly

Check all listed daily and weekly features.
Clean fresh-air filters.
Blow out compressor box and condensers.
Lubricate spline on Spicer drive shaft.
Inspect and clean contacts on control panel.

Monthly

Check all listed daily and semi-monthly features.
Clean control-panel contacts.
Inspect blower-fan motor and lubricate bearings.
Inspect and check expansion valves.
Test all thermostat tubes.
Clean pressure switch and check cut-in and cut-out pressures.
Test system for Freon leaks.
Operate system on standby one hour and check height of oil in compressor crank case and height of Freon in receiver tank.
Lubricate Spicer drive-shaft universal joints.
Inspect compressor motor and brushes.
Check for grounds in all electrical circuits.
Lubricate condenser-fan motor bearings (split unit).

Three Months

Check all daily, monthly, and semi-monthly features.
Inspect and lubricate compressor motor.

Start of Cooling Season and Six Months After

Check all listed daily, semi-monthly, and three-month features.
Wash evaporator and overhead heat coils.
Gauge all pulley grooves for wear.

ELECTRICAL SECTION

Batteries in Diesel Service*

By A. O. Ridgely†

Present average battery costs can be reduced more than one third by improvement of operating and maintenance practices

THE railroads represented here [six railroads and one terminal company] have in service, or on order, a total of more than 1,000 Diesel locomotive units using storage batteries. These batteries represent an investment of about $1,700,000. With good maintenance, the Exide-Ironclad battery will give at least 10 years service. If 10 years of life is obtained, the annual cost is about $170,000. The present average life is only about six years, and the annual cost is about $283,000. On the present life basis, the annual loss in battery life will be about $113,000, and, unfortunately, this loss is only part of the total.

There are two main causes for the present low battery life: high voltage-regulator settings; and over-filling of cells with water. Both cause wet, acid-soaked, grounded batteries, making it necessary to clean and water them about two to three times each month to prevent ground failures. It takes about two man-hours of labor to clean and water a battery: thus, if done twice each month, 1,000 Diesel units will require 48,000 hr. of labor each year.

With good maintenance, the battery requires water once each month and cleaning once every three months. This will require about 16 hr. of labor per year, or 16,000 hr. for 1,000 units. Thus, the labor wasted through these causes is about 32,000 hr., which cost the railroads approximately $45,000 a year. We are wasting $45,000 worth of labor to destroy $113,000 worth of batteries. The waste of $158,000 per year can readily be evaluated but it is only a part of the total loss, because there are other factors that cannot easily be evaluated, including acid damage to battery compartment, cost of shopping batteries more frequently than should be necessary and cost of more failures.

Unnecessary Burning of Lights

Another factor which contributes to loss in battery life is the unnecessary burning of lights when the engines are shut down. I have seen many Diesels stand four to five hours on side tracks at shops with engines shut down and all lights burning. This load was on the battery. If the lights are used off the battery four hours, the battery is about 20 per cent discharged. The life of the storage battery is influenced by the amount of work it is required to do, and this unnecessary burning of lights causes the Diesel battery to wear out prematurely. All of this adds up to the fact that our Diesel batteries are costing about twice as much as they would if properly maintained.

Our railroads are responsible for any improper battery performance because they have failed to provide maintenance electricians with a correct Diesel battery-maintenance program and to establish modern battery servicing shops. I do not know of a properly equipped Diesel battery shop on any of the roads represented here today.

*Abstract of a paper presented at Jacksonville, Fla., before a meeting of the Southeastern Railway Diesel Club.

†The Electric Storage Battery Company, Philadelphia, Pa.

Battery Maintenance

When a new battery is received, it should be inspected for any damage or derangement during shipment, such as the loss or spillage of electrolyte. The vent plugs should be removed and each cell checked for electrolyte height. The electrolyte level of all cells should be ⅛ in. below the bottom of the filling tubes. If there is any evidence of spillage, the level should be restored by adding electrolyte of the same specific gravity as in the other cells of the set. If there is no electrolyte on hand, the battery should be filled with approved water and the specific gravity later adjusted when electrolyte is available. At this time a check should be made of the specific gravity. If it is 20 points or more below the fully charged gravity as shown on the nameplate, the battery should be given a freshening charge.

A freshening charge would consist of charging at the finish rate shown on the nameplate as long as hourly specific gravity readings of the lowest cell show an increase; it should be continued for three hours after the last increase is shown. If the battery is not placed in service immediately, a monthly check should be made of the specific gravity and the battery should be given a freshening charge when found 20 points or more below the fully charged value. A battery should be given a freshening charge before installing it in a locomotive.

The battery should be properly blocked in the compartment to prevent shifting of the trays during movement of the locomotive. The clearance between battery and blocking at the sides, back and front should be ⅛ in. When installing a battery, all parts to be bolted together should be made bright and clean. The tray terminal posts should be scraped bright and clean. Lead-plated connector lugs should be wiped clean so as not to scrape away the lead coating. A thin film of No-Ox-Id grease or vaseline around the bolt holes of the terminals and connectors and also on the studs of the connector bolts, should be applied. After all connections are bolted tight, all surplus No-Ox-Id grease should be wiped off. The nuts should be gone over after the first tightening to make sure they are snug.

Flushing

There are two very important things to consider when adding water to a battery. These are the quality of water and the height to which water is added. The quality of water to add is approved or distilled water. Approved water is that which has been analyzed and found safe for storage-battery use. The local source of water is usually suitable, but should not be used unless it has been analyzed and found so. Water should be added to a battery with sufficient frequency to keep the electrolyte level always between the splash cover (the low level) and ⅛ in. below the bottom of the filling tube (the high level). The electrolyte level should not be permitted to drop below the splash cover. Water should be added in time to prevent this. If water is added higher than the bottom of the filling tube, the electrolyte will expand when the battery gasses on charge, and it will be pushed out through the opening in the vent plug with consequent damaging effect. This acid, lost from the cells, causes grounds, rotting of trays and lowering of the full charge gravity, which gives false indications of the state of charge for voltage-regulator adjustments, and a reduction in battery capacity.

When it is impossible to see into the filling holes an automatic cell filler should be used. If the voltage regulator is properly adjusted, the water space in MVAHT-25 Exide-Ironclad cells in sufficient easily to last two to three months. Water is usually added when the locomotive is out of service for the monthly inspection. During freezing weather, water should be added just before the locomotive goes into service, so the charging current will mix the water with the electrolyte and prevent freezing of the water added.

The amount of water used is a good indication of the correctness of the amount of charge the battery is receiving. When the amount of charge is correct, the battery must use some water. As a general rule, a battery in good condition using more than approximately ½ in. of water per month is receiving too much charge, and if it uses less than approximately ¼ in. per month, it is not receiving sufficient charge. All cells should require the same amount of water.

Pilot Cell

The specific gravity of the electrolyte indicates the state of charge of a battery. For the purpose of taking gravity readings, one vent plug in each battery compartment should be of a different color from that of the other plugs (white porcelain vent plugs are available for this purpose), and be known as the pilot cell. Each time a gravity reading is taken, a very small amount of electrolyte is left in the hydrometer and is lost from the cell. If the same pilot cell is used year in and year out, the specific gravity of this cell would in time become a number of points lower than the other cells of the battery. For this reason, the pilot cell vent plugs should be changed to a different cell each month to spread the electrolyte loss over the entire battery.

Hydrometer readings should not be taken immediately after adding water to the battery. A day or so should be allowed for the water to mix with the electrolyte. Otherwise, the reading will be false. Specific gravity readings are affected by the temperature of the electrolyte. The standard temperature to which all temperature readings are referred is 77 deg. F. At this temperature no correction is made to a hydrometer reading. For each 3 deg. F., the electrolyte temperature is above 77 deg. F., .001 (1 point) must be added to the hydrometer reading. For each 3 deg. F. below 77 deg. F., .001 (1 point) must be subtracted from the hydrometer reading.

Cleaning

A battery should be kept clean. Cleanliness not only invites good maintenance but is a part of good maintenance and is an indicator of the quality of the maintenance work done.

A poorly maintained and dirty battery will develop grounds that may lead to trouble with the electrical circuits. To keep a battery clean, it should be washed with water under moderate pressure as often as necessary. If the tops of the cells are damp with electrolyte, they should be neutralized by applying a bicarbonate of soda solution, using one pound of soda to a gallon of water. The soda should first be mixed with water before applying. Before washing a battery, make sure that all vent plugs are in place and tight to prevent the soda solution from getting into the cells. After the battery itself is hosed off, the water pressure should be increased to wash out the battery compartment around the sides and underneath the trays.

Generator Voltage

The ideal setting of the generator voltage regulator would be that which will maintain the specific gravity of the electrolyte at about its full charge value without generally exceeding a water loss of ½ in. a month. When setting the voltage regulator, a standard value cannot be given as this will depend upon the working schedule of the locomotive and seasonal temperature changes. For a trial beginning, set the regulator to hold a voltage at the regulator panel at both idling and operating speed, and the equipment at operating temperature, equal to 2.32 volts per cell.

After this, the necessity for a change in the regulator setting can only be determined satisfactorily by maintaining continuous records of specific gravity, water additions and electrolyte temperature.

When checking the regulator setting, make sure that the regulator coils are hot. If they are cold, the setting will be 2 to 3 volts higher when they are hot. Regulator coils are normally hot after 1 to 2 hours use. All loads except the continuous loads should be off the battery, if possible. Check the voltage at idling and full engine speeds. Both readings should be about the same. If there is too wide a variation which cannot be corrected by adjustment, the regulator should be changed out and overhauled.

Maintenance and Testing Tools

Tools should include a voltmeter and leads, a hydrometer, a thermometer, an Exide LV type cell filler and a rubber stick for measuring the height of the electrolyte. The voltmeter should have a 150-volt and a 3-volt scale. The scale should be such as to read readily the difference between 75 and 76 volts or 130 and 131 volts. It should be compared from time to time with a standard as a check on its accuracy.

The hydrometer should be of an accurate type and have a float with a range of from 1.100 to 1.300 sp. gr., graduated in 5 scale divisions (.005 points sp. gr.) for easy and close reading. Dirty hydrometers will give inaccurate readings. If the electrolyte temperature is very much above or below 77 deg. F., the readings should be corrected for temperature. The amount of water added to a battery should be measured with a measuring stick, before and after adding water.

Inspections and Records

A systematic program of inspection, including written records, must be set up as a guide to be followed and adhered to. Three types of inspections are necessary: routine, monthly and semi-annual.

Routine inspections of the battery are made every four or five days to insure its being maintained in serviceable condition. These inspections require only a few minutes and should be made immediately upon the arrival of the locomotive at the inspection point. The routine inspection should include the following items:

(a) Read and record on the battery record card the specific gravity solution height and temperature of the pilot cell in each half of the battery. If the battery is found discharged 100 points below full charge, a starting failure may result and a boost charge should be given. The amount of charge need be only sufficient to get the locomotive in service. The cause for the discharged battery should be determined and corrected.

(b) Measure the height of the solution in the pilot cells. Add water to the battery, if needed, and record on the battery record card the height of solution before adding water (in eighths of an inch). A good measuring stick may be made from a ¼-in. x ¼-in. x 4-in. piece of soft rubber or rubber belt, with one end marked in eighths of an inch.

(c) Examine the tray blocking for security.

(d) Examine the battery wiring and all bolted connections. See that wire insulation is in good order and that all bolted connections are tight and free from corrosion.

(e) Examine the battery for evidence of breakage or leakage which may result from a broken container, cover, sealing compound, missing or loose vent plugs.

(f) See that all vent plugs are securely in place.

Monthly Inspections

Monthly battery inspections are made to see that the battery is being maintained in serviceable condition, the charging equipment is properly adjusted and to perform such servicing as may be required by the battery or charging equipment. This inspection should be made immediately upon arrival of a locomotive at the inspection point. The monthly inspection should include all items as listed under routine inspections plus the following:

(a) Add water to the battery to bring the solution height to the proper level (⅛ in. below bottom of filling tubes) and record on the battery record card in inches the amount of water added (nearest ⅛ in.).

(b) Change pilot cells.

(c) Check the auxiliary-generator voltage-regulator setting at both idling and running speeds. Record on the battery record card the voltage as found and as left. Idling- and running-speed voltages should be about the same.

Semi-Annual Inspections

The semi-annual inspection is made to see that the battery is being maintained in serviceable condition and to insure its being capable of continuing to perform satisfactorily. The semi-annual inspection should include, in addition to all items specified under monthly inspections, tests to determine the condition of each cell. Ordinarily a specific gravity reading of each cell is sufficient, but when a battery has shown any indications of improper performance, or should the specific gravity readings show a difference of more than 40 points between the highest and lowest reading cells, a more thorough inspection is necessary.

When a battery's performance has been satisfactory, the semi-annual inspection should include the following:

(a) Read and record on the battery record card the specific gravity and solution height of each cell and the temperature of the pilot cells.

(b) All the items listed under monthly inspections.

When a battery's performance has not been satisfactory or when the specific gravity readings show a difference of 40 points or more between the highest and lowest reading cells—(be sure that the gravity difference is not caused by a difference in solution height)—proceed as follows:

(a) Add water to the battery until the solution level is ⅛ in. below the bottom of the filling tubes in all cells.

(b) Charge the battery, continuing the charge at the battery's normal rate until the temperature-corrected specific gravity of the pilot cells has risen to the maximum and then shown no increase for two hours. Record the charging rate and the number of hours that the charge is given.

(c) Just before stopping the charge, read and record the voltage of each cell.

(d) Stop the charge.

(e) Read and record the specific gravity of each cell and the temperature of the pilot cells.

(f) The battery or tray should be removed from the locomotive for shop repairs if the specific gravity of any cell reads 40 points or more lower than the highest reading cell, if the average full-charge specific gravity of all cells is more than 20 points below the full-charge specific gravity, or if other repairs are required.

Experience indicates that very few Diesel batteries ever require special charging. A wide spread in specific gravity usually results from too much water having been put in the cells or from leaky sealing compound. Leaky sealing compound may quickly be detected by making a pressure test. A vent plug to which a length of about 2-ft. of of ¼-in. soft rubber hose has been attached is ideal for the purpose. Air blown from the mouth into the hose gives sufficient pressure to show any leakage. It is necessary to be careful not to blow too hard because acid may be thrown for several feet if there are bad leaks present.

Diesel Battery Record Card

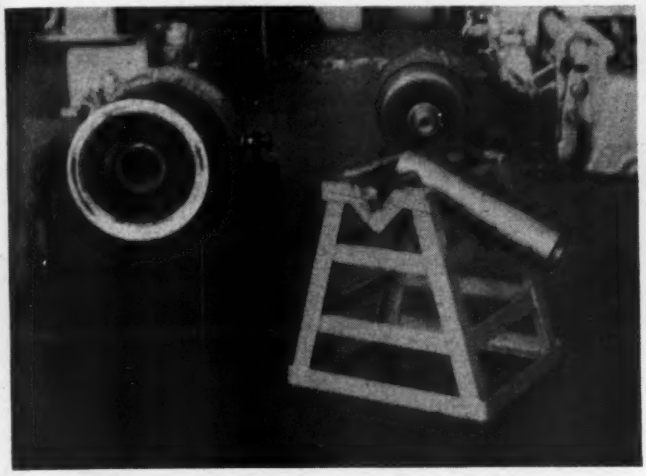
A battery record card should be carried in each Diesel unit in a suitable card holder. This card provides spaces to record, for a period of six months, all of the information needed for the proper maintenance of the battery. A glance at the card will indicate the proper place to record the information required after each inspection. Without such a record, it is almost impossible for the Diesel electrician to keep his generator voltage properly adjusted.

Armature-Turning Device

The armature-turning device, shown in the illustration, is a recent development at the West Burlington Diesel shop of the Chicago, Burlington & Quincy. It is used to turn armatures from a horizontal position in which they are handled in a sling, to a vertical position in which a threaded cap and clevis screwed to the threaded end of the armature shaft is used as the attachment to the crane hook. The device consists simply of a welded steel frame which supports a 2-in. round pivot bar passing through a shaft extension bushing suitably bored to receive one end of the armature shaft while the other end is being lifted with the shop crane.

The steel frame of this device is made of 2-in. steel angles and reinforcing strips. The base is 24 in. by 20 in. and the height 23 in. This height was selected to match the

height of the armature shafts when the armature is lying on one of the saddle blocks on which they are placed between operations. The upper cross member on each side of the device is veed downward at the center to support the 2-in. pivot bar which is 23 in. long and held in place, but not prevented from turning, by a steel strap. The shaft extension bushing, 5¼ in. in outside diameter by 19 in. long, is drilled at one end to receive the pivot bar and bored longitudinally at the other end .005 in. larger than



One advantage afforded by this armature turning device is that it is readily portable

the armature shaft. The wall of the bushing is drilled and tapped and a ¾-in. set screw inserted to hold the armature shaft after being inserted.

By means of the threaded cap and clevis connection to the other end of the armature shaft, the shop crane may be used to swing the armature into a vertical position for impregnating with varnish or movement to the hydraulic press for pressing out the shaft. As compared with former hand-blocking methods, this device eliminates the possibility of the armature slipping while being up ended, with the attendant likelihood of damage to the commutator and injury to the shopmen.

A.C. Compressor Valve and Seal Grinder

THE Southern Pacific at its shops in Sacramento, Calif., employs a grinder for facing Waukesha compressor intake and exhaust valves and valve plates, for grinding rotary compressor seals and Ensign fuel regulator pilot valves and seats. The grinder consists of a rotating head, driven by an air motor at a speed of about 120 revolutions per minute.

Various lapping plates are applied to the head. For Waukesha compressor valves, the lapping plate shown in Fig. 1 is used. The outer diameter of the plate is 8 in. and the width of the outer lapping surface, or ring, is ¾ in. The slot between the outer and inner ring is 3/16 in. wide and the inner lapping ring is 5½ in. in diameter.

To grind a valve, the operator first applies a small amount of extra fine grinding compound to the horizontal lapping surfaces of the plate. He then drops the stem of the valve into the slot in the plate and, by hand, rotates the valve slowly around the grinder spindle in the direction opposite to the rotation of the plate. This assures that all contact surfaces of the valve are flat and receive the same amount of grinding.

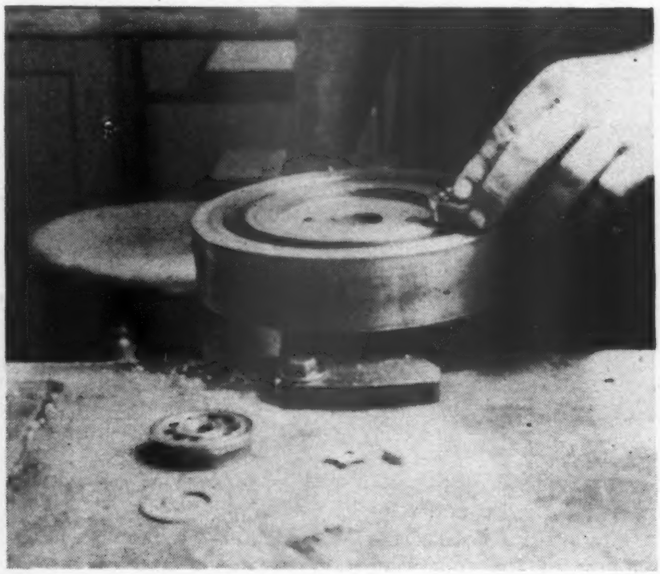


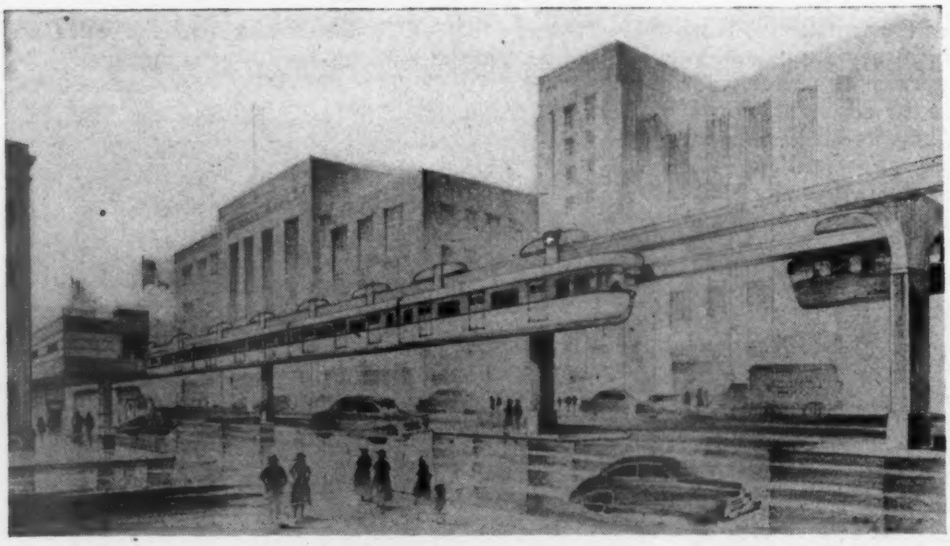
Fig. 1—The grinder as used for surfacing a compressor valve

For valve plates, a flat lapping plate as shown in Fig. 2 is used. The valve plate is held in the grinding position by means of a small wooden knob having a boss on its lower surface which fits the inner opening of the valve plate. During the process of grinding, the valve plate is moved in a circle opposite to the rotation of the lapping plate as in the case of grinding the valves.

For grinding compressor seals, a 3½-in. glass disc backed by a rubber friction disc is used. This is placed on the face plate and the upper surface coated with grinding compound. For this operation, the seal is held at the center of the face plate.

Fig. 2—A flat lapping plate is used for compressor-valve plates

Ensign valves and plates are ground on a flat lapping plate. One end of the valve or plate to be ground is supported on a flat rest. This rest is placed at the edge of the lapping plate with its surface at the same



Artist's conception of suspended monorail system of transportation

height as that of the plate. The surface of the valve or seat to be ground rests on the lapping plate.

The procedure has resulted in doing the work in a fraction of the time required previously and produces much improved valves which give little or no trouble in service. The grinder was developed by W. H. Pedrick.

A Suspended Monorail System

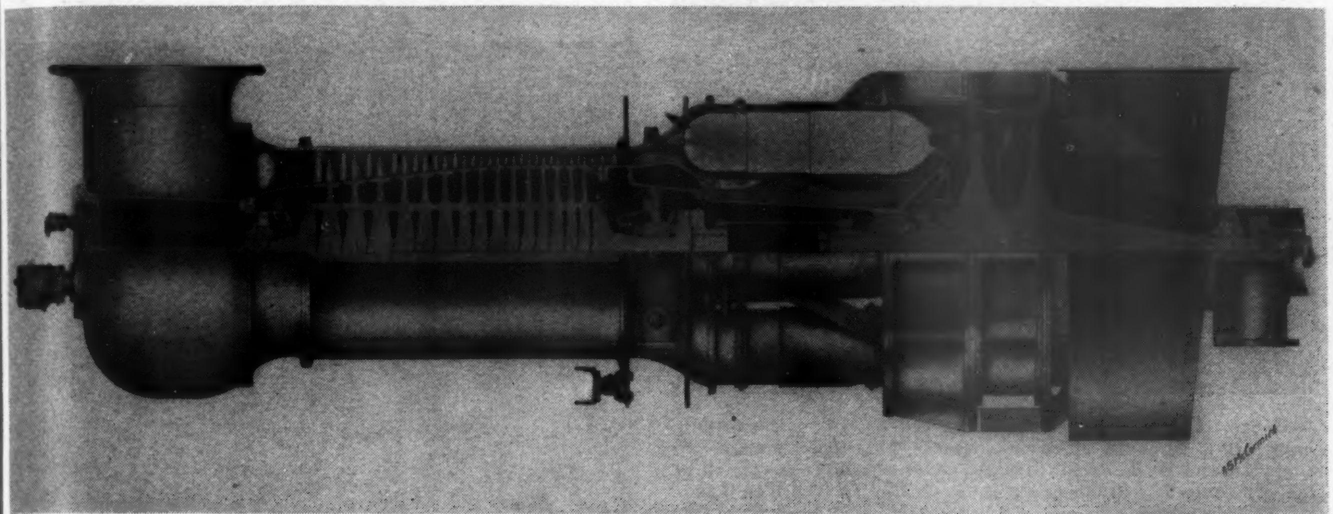
A suspended monorail system for relieving traffic congestion in cities has been proposed by Gibbs & Hill, Inc., consulting engineers, New York. A quite completely engineered description of the system was presented before a meeting of the New York Railroad Club, held in New York, on Thursday evening, February 19, 1948, by Edward H. Anson, vice president of Gibbs & Hill, Inc.

Basically, the system consists of a series of supporting structures, extended along the center of the street, with transverse brackets on one or both sides for suspending the trains from the overhead monorail. The cars operated in these trains would be similar in construction and performance characteristics to the P.C.C. cars now extensively used for street railways. Advantages offered for such a system are that it would remove traffic congestion from the streets, trains would not be impeded by other surface traffic, there would be no snow removal problem, it would cost much less than a subway, no pumping of seepage or flood wastes would be required, and it provides an open-air ride. As compared with other forms of elevated railways, the monorail would not include flooring over the street with its consequent depreciation of abutting property values. Also, since there would be a single row of supporting columns, which could be placed in a center island section of the street, there would be no interference to surface traffic.

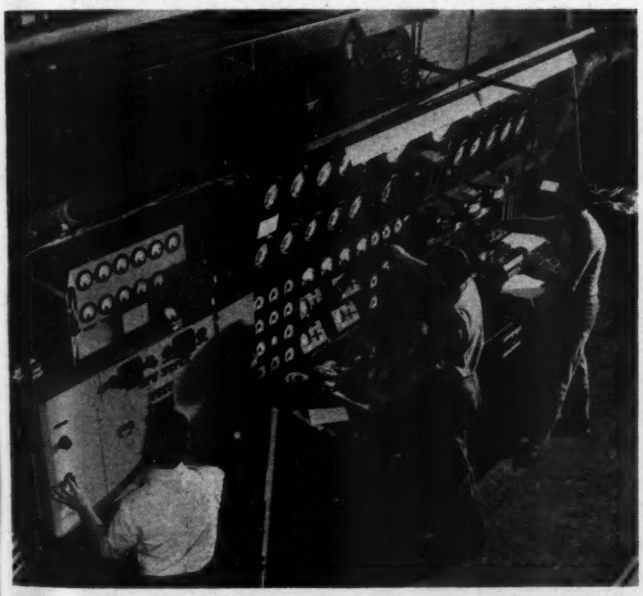
* * *

Electric locomotives under construction for service on the Central Railways of Brazil—These cabs, trucks, and controls at the East Pittsburgh Works of the Westinghouse Electric Corporation will shortly be assembled into complete locomotives — When finished, each will weigh 165 metric tons and will be driven by six electric motors totaling 4,000 hp. at 3,000 volts d. c.

G. E. Demonstrates Gas Turbine



Sectional view of the power plant showing the 15-stage compressor, the combustion chambers and the two-stage turbine



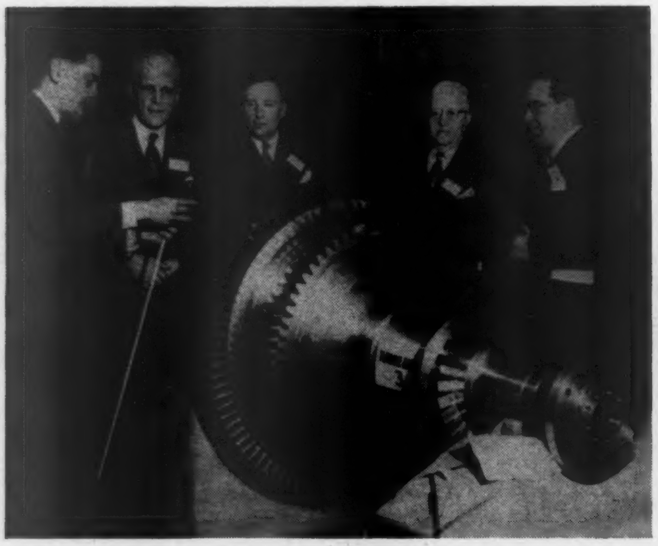
Manufacturer expects to have power plant operating a locomotive within next two years

A GAS-turbine power plant for locomotive application, and the laboratory devoted to the development of the special materials required for the turbine, were demonstrated to a group of railroad executives and engineers by the General Electric Company, at Schenectady, N. Y., on March 3, 1948. The laboratory conducts elaborate tests, many of them at elevated temperatures, for such characteristics as tensile strength, fatigue, resistance to erosion, vibration, damping and creep, some of these tests requiring the maintenance of specimens at high temperatures for periods up to eleven years.

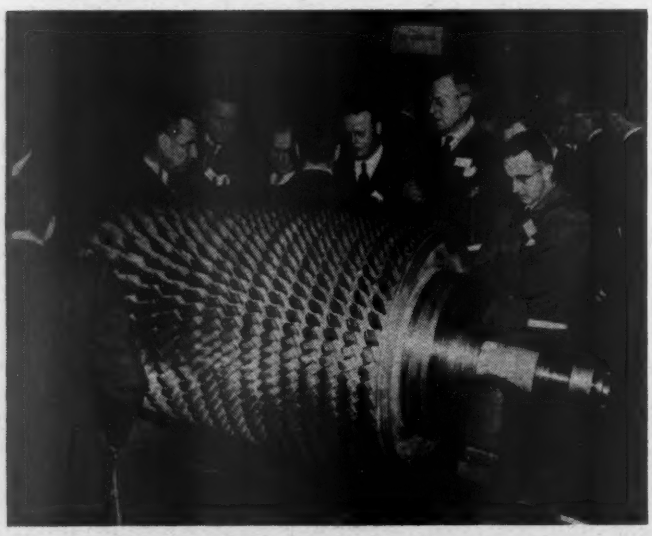
The power plant was exhibited in operation on a test

Above: Turbine test control station—The light-colored panel at the left is the starting and control panel which will be installed in the locomotive cab

Right: The power plant on the test stand being made ready for operation



A General Electric engineer discusses the design of the turbine rotor with F. G. Baker, electrical engineer, J. L. Ryan, mechanical engineer, and W. B. Berry, superintendent of motive power, all of the St. Louis-San Francisco, and C. C. Davis, American Locomotive Company



The compressor rotor being examined by a group of engineers

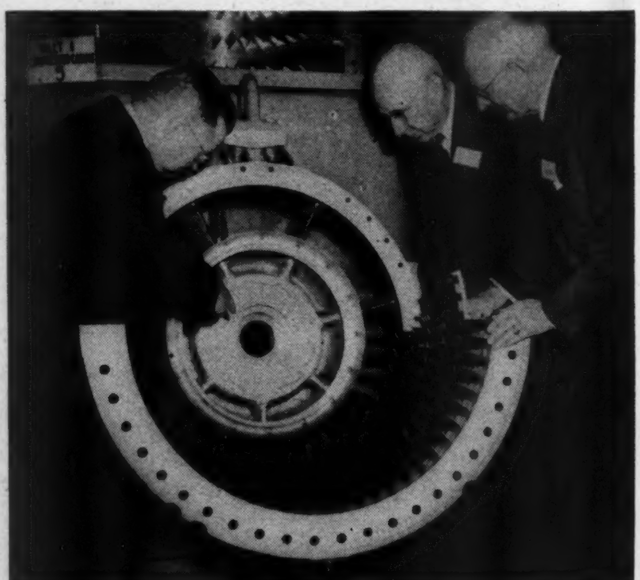
E. S. Gunn, of General Electric (left), and P. H. Hatch, general mechanical superintendent, New York, New Haven and Hartford, examine the main controls mounted at air intake end of turbine

stand. It includes a 15-stage axial-flow compressor, 6 combustion chambers, a 2-stage turbine, a reduction gear and 4 electric generators. At a rotor speed of 6,700 r.p.m., the plant develops 4,800 hp. At full speed, the compressor compresses 80,000 cu. ft. of air per min.

P. W. Kiefer, chief engineer motive power and rolling stock, New York Central, and J. D. Loftis, chief of motive power and equipment, Atlantic Coast Line (right) in front of the air intake end of the turbine—The duct above is used for test purposes only

to a pressure of five atmospheres to the combustion chambers.

In these combustion chambers the air is mixed and burned with atomized Bunker C fuel. The combustion products, at an initial temperature of 1,400 deg. F., are



Left to right: G. W. Wilson, manager, General Electric Locomotive and Car Equipment Divisions, R. E. Woodruff, president of the Erie, and A. W. Munster, vice president of the Boston and Maine, are examining a cutaway section of the compressor housing

then expanded through a 2-stage turbine and discharged through an exhaust hood.

The total weight of the power producing unit, including the compressor, combustion chambers and turbine, is 20,000 lb. It is 19 ft. long and has an overall thermal efficiency of 17 per cent.

Norfolk & Western

Car Equipment Program*

By C. P. Taylor†

How one railroad is working out its car power supply, air conditioning and lighting problems— New cars on order will use two 20-kw. axle-driven generators

A FEW years ago, after several years experience with the design and operation of electrical power systems for passenger train cars, we realized that while the 110-volt d.c. system gave satisfactory performance, we finally concluded that an all-a.c. power distribution system on cars would be the most desirable, for the reason that standard a.c. equipment, such as motors, fans, water coolers, lighting equipment, and other miscellaneous appliances are easily commercially available, and on account of being produced in large quantities for domestic and industrial use, the cost would be less than any direct-current equipment. One of the main features which influenced our thoughts along the line of adopting the a.c. system was that there was a great possibility of there soon being available a.c. motor-driven, hermetically sealed refrigerant compressor units produced in large quantities for commercial use and readily available from service stations throughout the country when it was necessary to replace a compressor unit on a passenger car. The advantage of this would again be low first cost and elimination of belt drives and compressor shaft seals, which have been the source of some annoyance and also the cause of some cooling failures.

In order to secure the a.c. system, we thought it advisable to maintain the 110-volt, d.c. source of supply, namely, the generator and battery, on account of lower first cost, lower weight and higher efficiency. From there on, we decided that some means of conversion would be necessary. As there was nothing available on the market that seemed to suit the requirements, we constructed a 12-kw. inverted rotary converter for changing the d.c. to a.c. As the converter has a fixed ratio, we realized we could not secure more than about 71 volts, 3-phase, 60-cycle a.c. from the 110-volt, d.c. supply. In order to secure the 110 and 220-volt, 3-phase, 60-cycle, a.c., we had built a 12-kva., 70 to 220-volt, 3-phase, 60-cycle self-regulating transformer. This transformer solved the problem of voltage regulation over the voltages encountered with an 88-cell Edison battery while being charged or in a nearly discharged state. We regulated the frequency of the 71-volt output of the rotary converter by field control of the converter. This field control was a carbon-pile resistor which was controlled by a solenoid coil that was connected across the battery.

After this development, we found that the hermetically sealed motor compressor units were not then available, and that the 12-kw. converter would be too large and inefficient for the light load it would have to carry on a car, such as the lighting, blower fan and condenser fan.

Soon after this, the General Electric Company developed and designed a 6.25-kva. amplidyne booster type inverted rotary converter which has very satisfactory voltage and frequency regulation throughout the range of the d.c. voltages encountered with an 88-cell Edison storage battery while being charged or near the point of complete discharge.

Late in 1946, our management authorized the installation of air-conditioning and modernization of the last ten of our Class "Pg" day coaches. We decided that these cars would afford us an excellent opportunity to try out the 3-phase, a.c. power system, continuing the use of a d.c. generator and 88-cell nickel-iron battery for the initial source of power. We made a special effort in laying out the electrical apparatus to have as much of the electrical load as possible supplied from the a.c. system. The evaporator blower fan, condenser fan, water coolers and lighting—both fluorescent and incandescent—were arranged for a.c. operation. The only d.c. load on these cars is the night lights. These are 145-volt lamps which operate directly from the battery.

The toilet and passageway incandescent lights are normally a.c. but are controlled by a double-acting a.c. relay, so that if anything should happen to the amplidyne converter, this relay would switch the toilet and passageway lights onto the battery with a fixed resistor in the circuit to prevent over-voltage. The refrigerant compressor motor is a 12-hp. d.c. and a 15-hp. a.c. dual motor. The compressor is driven by the d.c. motor only when the car is not supplied with outside standby a.c. power. When outside a.c. power is connected, the entire a.c. load, including the compressor, is taken over by the standby and the d.c. compressor motor furnishes some battery charging.

A phase-reversal relay connected to the standby-power car receptacle initiates the change from a.c. power supplied by the amplidyne to the standby power. When a standby-power plug is inserted into the car receptacle, and, if the phase rotation of the standby power is correct, the phase-reversal relay closes, opening the control circuit to the amplidyne starter and closes the circuit to the a.c. compressor-motor starter so that this operates to start the a.c. compressor motor if the car is calling for cooling.

The changeover from the amplidyne a.c. power to standby power is accomplished by means of a triple-pole, double-throw a.c.-operated contactor. The contactor is held in closed position by the amplidyne voltage; likewise the contacts for the standby power close the contactor to connect the system with the standby power, at the same time disconnecting the amplidyne. Therefore, when the phase-reversal relay operates to stop the amplidyne, it no longer has voltage to hold the contactor in and allows the voltage from the standby power to pull the contactor in the opposite direction,

*Paper presented before the Railway Air-Conditioning Club, Roanoke, Va.
†Electrical Engineer, Norfolk & Western.

and thus have the effect of connecting the system to the standby power.

We have always considered that battery power is the most expensive power that we can use on a passenger-train car, and this is what prompted us to make every effort to relieve the battery of load wherever this is possible.

The a.c. system as we have worked it out for these cars permits us to eliminate the use of the so-called lamp regulator or voltage regulator, the loss through which is around 1 kw. or slightly more. The heat generated by the lamp or voltage regulator is additional heat energy that must be dissipated by refrigeration during the cooling season. The elimination of the losses chargeable to the conventional lamp regulator just about offsets the conversion losses of the amplidyne booster inverted converter.

Since the amplidyne produces 220 volts, 3-phase, 60-cycles, two 1½-kva. 220-volt to 110-volt, single-phase transformers connected open delta were installed to supply the 110 volts, 3-phase for lighting, water-cooler motors and other 110-volt commercial appliances that might be used. The 3-phase, 110 volts supplied by these transformers is balanced by connecting different lighting and other circuits to each phase.

Another advantage of the a.c. system is that the commutators and brushes are all at one point, namely, on the amplidyne, which can be mounted under the car, easily accessible, thus eliminating brush and commutator maintenance on blower fan, water cooler, exhaust fan and condenser fan motors.

The ten cars which were air-conditioned and modernized were conventional steel cars, built about 1913, having a clerestory. In the modernization, it was decided to lower the roof of the clerestory about 6 in., and install hood sheets on the side, which would give the car an appearance of the present A.A.R. recommended roof contour. This necessitated new interior head-lining, which was installed in conjunction with overhead Multi-Vent air discharge. Each Multi-Vent panel is equipped with a fluorescent lighting fixture, and in addition to the fluorescent lamp in this fixture, candelabra sockets are provided for small 145-volt lamps for night lights. The fluorescent lamps and the night lamps are controlled by a three-way switch so that both lamps cannot be burned at the same time. The brackets supporting the baggage racks are spaced so that there is one over the center of each seat. These brackets are equipped with an 18-in. fluorescent lamp with a plastic diffusing shade. Each light is individually controlled by a toggle switch within easy reach of the occupant of the seat.

New aluminum sash with sealed-in, shatterproof glass has been provided. New revolving adjustable, reclining seats were installed; Vapor Company's multi-fin radiation was provided, with Vapor automatic heat control. The finned floor-heat radiator pipes were covered with a stainless-steel shield with perforations in the side and louvers in the top near the side wall of the car, directing the heat along the panel under the window. The side of the stainless steel shield rests with some pressure on the rubber tile floor to prevent dirt and other foreign matter from getting under the radiator.

The trucks were rebuilt using hardened steel pins and bushings and roller bearings were applied. With the application of roller bearings the axle size was increased from A.A.R. 5-in. by 9-in. to 5½-in. by 10-in. A.A.R. standard.

The toilets were lined with stainless steel extending from the floor to the window sill and above the top of the wash basin. Specially designed fixtures were installed on each side of the mirrors to provide adequate illumination.

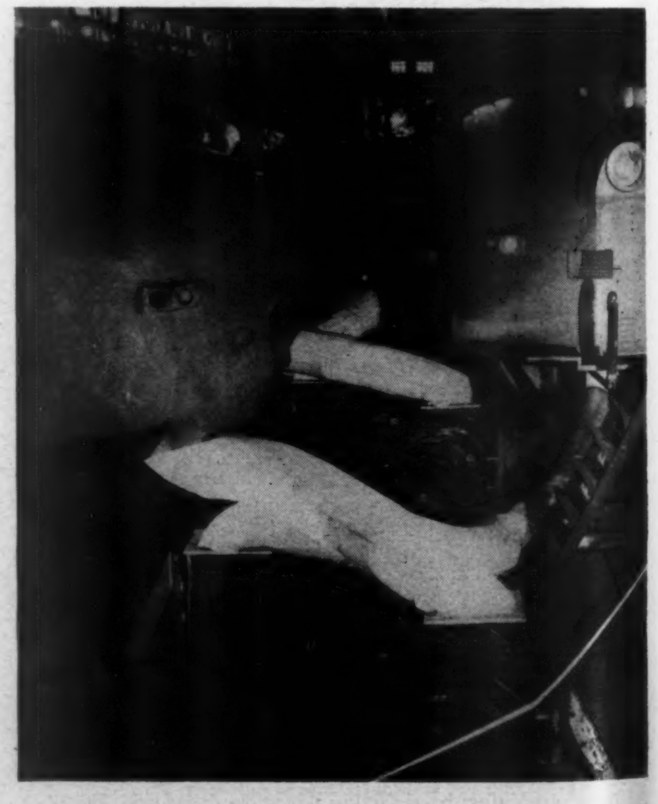
The 20-kw. generator is driven from one of the axles by a Spicer drive having a ratio of 3.09 to 1.

We are now having built by the Pullman-Standard Car Manufacturing Company 18 cars on which will be installed the a.c. system similar to that described above except that these cars will be equipped with two 20-kw. generators each. Past experience has indicated to us that the generator capacity should be in the neighborhood of three times the connected load.

We are having built by the Budd Company 20 bedroom-roomette sleeping cars. These cars will also be equipped with the a.c. system, two 20-kw. generators, Electro-Airmat and Dorex air filters.

The cars being built by Budd will have individual selective temperature control in each compartment so that the occupant of any one of them may select the temperature to suit his particular requirements regardless of the temperature desired by the occupants of other compartments. This will be accomplished by two air delivery ducts supplying each compartment. One duct will supply filtered outside fresh air; the other duct will supply cool or warm air as the season requires. These two ducts will be coupled together by a thermostatically controlled damper, mixing the air from the two ducts, thus supplying the desired temperature selected by the occupant of the compartment.

* * *

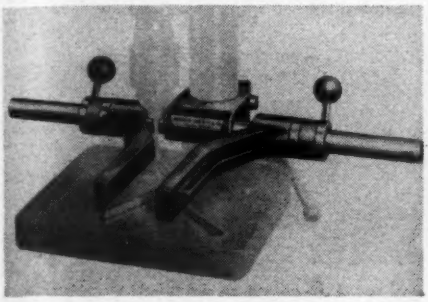


Load testing electric locomotives without tracks—Complete simulated road tests are being run on these electric locomotives destined for Central Railways of Brazil at the East Pittsburgh Work of Westinghouse Electric Corporation—To check performance of the traction motors under varying load conditions (starting, level, up-grade and down-grade running and stopping) the six motors of the one locomotive actually drive the six of the other one, as all 12 are connected to the same shaft through their driving gears—The canvas tubes bring cooling air from the fans in the cabs to the traction motors.

NEW DEVICES

Safety Work Holder

To help prevent drill press accidents, improve quality and increase production, a safety work-holder which clamps to the column of any small standard drill press and secures the work with



Work piece being held by the Universal Safety Work Holder

only a quarter-turn of a single lever has been developed by the Universal Vice & Tool Co., Parma, Mich. The tool can substitute for simple drill jigs, and replace bolts and C-clamps.

The clamping arms are instantly adjustable along the length of the cross arm to encompass the full wides of the drill press table and swing back to clear a drill jig or machine vise when necessary. Standard sizes fit drill press columns with diameters of 1⅝, 2¼, 2¾, 3, 3½, 3¾ or 4 in.

Band Saw For Cutting Metal

The Kalamazoo band saw features an endless blade and a built-in, off-the-floor coolant system which permit continuous wet cutting of the metal stock. It has an 8-inch throat to handle the majority of cut-off work and a 16-in. vise opening to broaden the capacity for handling large pieces of stock; for cutting stock above this size there is an extra-capacity model with a 24-in. vise opening.

The saw frame is entirely enclosed to reduce the danger of injuries and to catch the drip of the coolant which drains back into a pan on the back travel of the blade. A tension spring compensates for different cuts and for the progressive

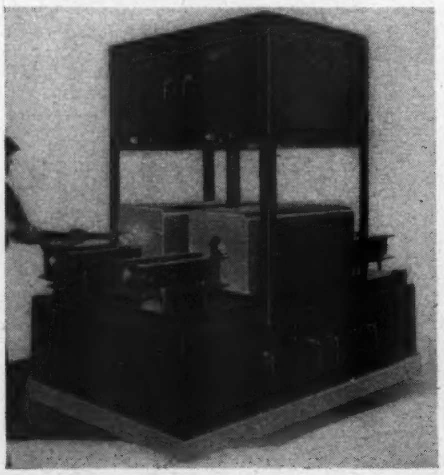
Bandsaw for cutting metal

dulling of the blade by changing the blade pressure. The cutting action of the saw is visible from above at all times so that necessary adjustments can be made. A hydraulic frame cushion is incorporated to lessen the risk of breaking blades due to the dropping of the frame while cutting thin sections. This control causes the frame to descend slowly on an oil cushion; the descent may be stopped at any position or slowed up by closing a valve.

In this product of the Kalamazoo Tank & Silo Co., Machine Tool Division, Kalamazoo, Mich., there are four speeds available—266, 160, 96 and 53 ft. per min. Two additional speeds may be obtained by reversing the machine and motor pulleys. In this case the high speed becomes 480 ft. per min. and the low speed 96 ft. per min., while the intermediate speeds remain the same.

Forge Shop Induction Heaters

Designed to eliminate the waste caused by attempting to forge bars that have cooled below the proper forging temperature during preliminary operations, the Ajax-Northrup induction heater reheats



The Ajax high-frequency induction heater reheats the forging piece to the desired forging temperature

the piece the few hundred degrees required to bring it back to the proper forging temperature. The high-frequency heater is located at the forging machine and turns out a bar a minute.

This product of the Ajax Electrothermic Corporation, Trenton 5, N.J., is self-contained, and is controlled by a foot switch. Bars 4 in. square and up to a yard long which have cooled are fed onto rollers to the induction furnace where they are reheated on an automatically timed heating cycle to emerge at the exact forging temperature desired. Rejects are reduced and forging speeded up because forging is not done after the stock has dropped to 2,000-2,100 deg. F.

The heater has twin heating coils, each of which draws 125 kw. of 960-cycle power from a 700-kw., 960-cycle, 400-volt motor-generator unit. One motor-generator supplies power for two twin heaters, or four work stations. The heating coils are interchanged when switching from one job to another. The capacitors are located in the bottom of the integral cubicle, while the timers, contactors, etc., are in the overhead section.

Amplidyne Motor Control

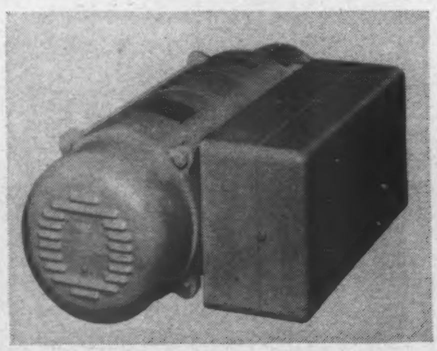
An electronic amplidyne consisting of a high-gain balanced d.c. electronic amplifier and a motor amplidyne has been announced by the motor divisions of the General Electric Company. The new equipment is a high-capacity amplifier which is useful in many types of motor control where precise regulation of current, voltage, and speed is necessary.

Designed for use as a regulated adjustable-voltage power supply for d.c. motors up to 1½ hp. and as a regulated exciter for larger adjustable-voltage drives up to 200 hp., the new equipment is arranged for use on either a 220- or 440-volt, 3-phase, 60-cycle power supply.

The electronic amplidyne makes possible a speed range of 20 to 1 or greater. It maintains speed closely at any setting, regardless of load conditions. It assures smooth, rapid acceleration and reduces starting shock on the driven machine by means of current limit control of acceleration and stalled current.

Quick stopping without undue stress to motor or driven load is provided by suicide braking utilizing current limited regeneration. The equipment satisfactorily maintains speed on overhauling loads where the motor is required to absorb power and act as a brake during part of the loading cycle.

Design features include a completely balanced amplifier which is insensitive to line voltage changes; an industrial electronic amplifier with hinged panel

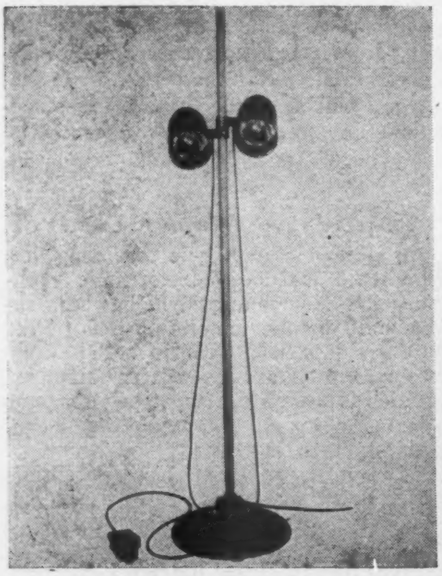


The General Electric electronic amplidyne

which provides easy access to all parts and connections; a circuit which is easily adjusted for various operating conditions, and a locking device which maintains settings once the circuit has been adjusted. Double end ventilation is provided.

Welding Spot Light

An industrial spot light powerful enough to illuminate clearly welding, cutting, or brazing work when viewed through a No. 10 welder's glass before striking the arc is announced by Westinghouse



Two of the high-intensity spot lights mounted on a stand

Electric Corporation. Particularly applicable for repetitive work, one of these spot lights casts a small-diameter circle of light of from 2,500-footcandle brilliance when placed three feet from the work to 1,000 footcandles when located six feet away. Two or more lights can be used if desired for any application requiring a small area of very high illumination.

The spot light uses a six-volt, sealed-beam type of lamp operated from a transformer built into the light housing, the complete assembly weighing approximately five lb. It can be mounted at any angle on some convenient one-inch pipe or on its own stand by means of a clamp and positive-action spring-loaded swivel joint. The spot lights can be plugged into any service outlet since power requirement for the lamp and accessories is only 30 watts at 115 volts, 60 cycles. Work is made cooler and more comfortable since practically no heat is generated by the spot light because of its extremely low power consumption. Previous lights for this purpose operated at 300 to 450 watts.

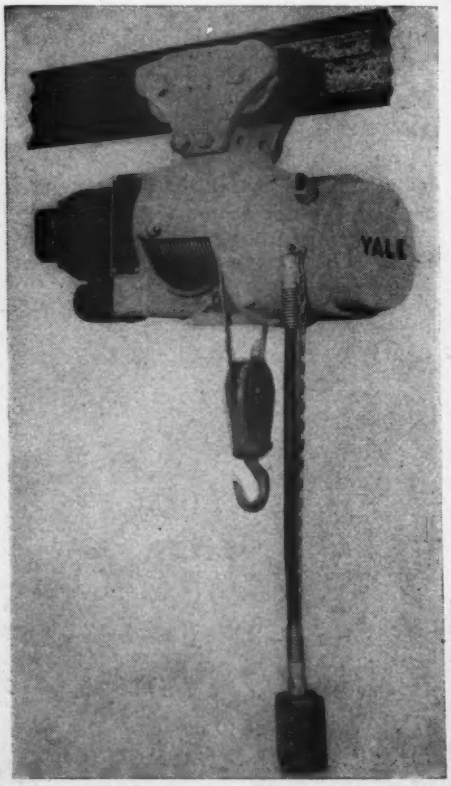
The high-intensity industrial spot lights are available as single units complete with built-in transformer and clamp or in a combination of two spot lights and a six-ft. pipe stand with built-in receptacles, a foot-operated switch, and power cord.

Wire Rope Hoist

A line of low-cost, low-capacity electric hoists has been designed to bring the advantage of cable and drum hoisting to a wider industry group by the Yale & Towne Manufacturing Company, Philadelphia Division, 4530 Tacony street, Philadelphia 24, Pa. The light-duty hoists are known as the Load King group and are available in ¼-, ½- and 1-ton capacities.

Each size hoist has machine-cut grooves for guiding the cable as it winds in the drum, which is of sufficient diameter and length to permit enough cable for the full standard lift in each model to wind about the drum without overlapping the cable. The driving motor is of the reversing type and is rated to operate under constant service with full load without overheating.

The frame of the Load King is a one-piece, ribbed-steel casting. It is con-



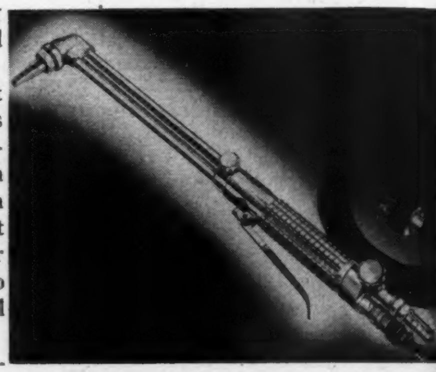
The Load King wire-rope hoist is manufactured in ¼-, ½-, and 1-ton capacities

structed for use with the lug, plain trolley, motor trolley or winch-type mounting.

Hand Torch For Cutting Stainless Steel

A hand torch for cutting stainless steel using Airco's Flux-Injection process has been developed by the Air Reduction Sales Company, 60 East Forty-second street, New York 17. The torch is made in lengths of 21 in. and 36 in., both of which come with a 90-deg. torch head. The general design is in many respects similar to the Airco Series 9000 cutting torch, thereby minimizing the inventory of replacement parts.

Specific features of the torch for cutting stainless steel include a Monel-metal head, a stainless-steel operating lever and a ribbed handle. The torch has three



The Airco hand torch for cutting stainless steel

tubes, the third one being used for carrying the cutting oxygen and flux; all tubes are made of stainless steel for rigidity and resistance to heat. The need for a separate flux control is eliminated by the remote control cut-off which automatically coordinates the flux feed with the cutting oxygen. Standard cutting tips are used.

Vibration Damping Socket

A molded, Neoprene Edison-base lamp socket designed to prolong the life of electric lamps by protecting bulb filaments from surrounding vibration, is being offered by the Mines Equipment Company, St. Louis, Mo. Molded as a unit to a resilient rubber mounting diaphragm that fits a standard four-inch wall outlet box, all necessary metal parts

The socket protects the lamp from vibration and is also moistureproof

such as female socket, wires, connections, etc., are protectively encased in oil-, acid-, heat-, and wear-resistent rubber-like compound. In addition, a rubber bead on the socket's mouth fits the lamp neck snugly. This seals the socket-lamp assembly, protecting its electrical

connections against water, dust, oil, etc.

In a test now underway in a mill in which there is considerable vibration, a 100-watt lamp in one of the vibration-proof sockets has already outlasted three lamps in ordinary sockets.

Spray Gun

A spray gun said to produce a smooth, high-gloss finish by fine atomization and even paint distribution because of a uniform flow of air and paint is made by the American Brake Shoe Company, Kel-

The Micro-Spray requires only three spray heads to cover the full range of paint spray materials

logg Division, 97 Humboldt street, Rochester 9, N.Y., under the trade name Micro-Spray. Large air passages have been designed in the gun body and the flow and size of the air streams from both wing jets and the center orifice are made uniform to reduce detrimental effects from air-pressure drop and eddy currents.

The entire head can be removed as a unit by removing the locking screw and lock nut. Only one fluid needle is required for all paint spraying. Spring-loaded, self-adjusting packing at the fluid needle and air-valve stem are used to prevent leakage and the need for adjustment, while the design of the air and fluid connections permits removal of the container and hose without disturbing or damaging connections to the gun.

The fluid needle assembly can be removed in one piece for cleaning. The needle is a self-aligning cartridge type with full-floating motion in all directions to give a tight, wear-resistant seal. The adjusting knob is close to the body to minimize damage and interference with the work.

Control of the spray width is by the angle of the needle, and a large number of revolutions are required to change the air flow a small amount. A built-in lever controls the air volume according to the setting marked on the gun body. In the event a change in the pattern from horizontal to vertical is desired, the air cap can be turned freely by the fingers without loosening or adjusting the air-cap ring nut. Only three spray heads are needed to cover the full range of paint spray materials. Air cap and fluid nozzles have been designed so that any of the three combinations may be used for both siphon and pressure spraying.

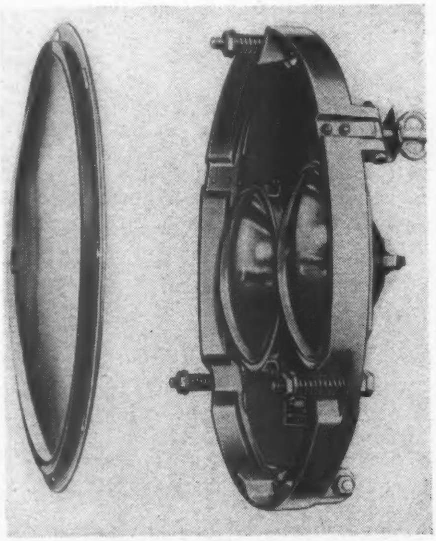
Flat-Stem Thermometer

The Dillon flat-stem dial-type thermometer has been designed to clamp primarily onto flat or rectangular surfaces, such as power bus-bars, switch blades, engine blocks, water jackets, etc. With this flat-stem design, the heat element goes down snugly against the object under test and presents a wide heat absorbing area. The thermometer may be held by ordinary C-clamps, or it can be drilled and tapped and screwed down in any desirable position.

The thermometer can be supplied in flat stems in a wide range of metals of varying widths, thicknesses and lengths by the W. C. Dillon & Co., Inc., 5410 West Harrison street, Chicago 44. The following temperature ranges are standard: O-200 deg. F., 50-500 deg. F., 150-750 deg. F., and 200-1000 deg. F. Centigrade ranges are available on order. Standard dial diameters are 3 and 5 in.

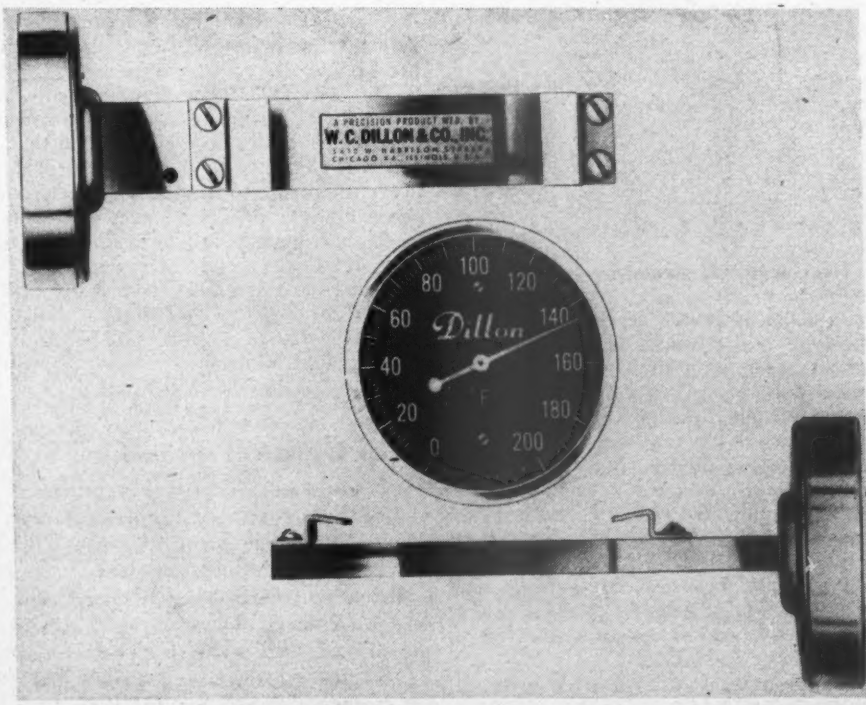
Sealed-Beam Headlights

The Pyle-National Company, Chicago, is now in production on a dual sealed-beam headlight assembly for use on road locomotives. The manufacturer has, for several years, been working on the development of the sealed beam lamp for



Headlight interior for adapting sealed-beam lamps to a standard headlight case

locomotive use in collaboration with the lamp manufacturer and the railroads. The headlight consists primarily of two sealed-beam lamps so aligned within the headlight housing as to give the effect of a single beam. The lamps are 200-watt PAR-56 and can be obtained for 12-, 30-, or 32-volt operation. Each



The Dillon flat-stem thermometer equipped with brackets to secure it to bus bars

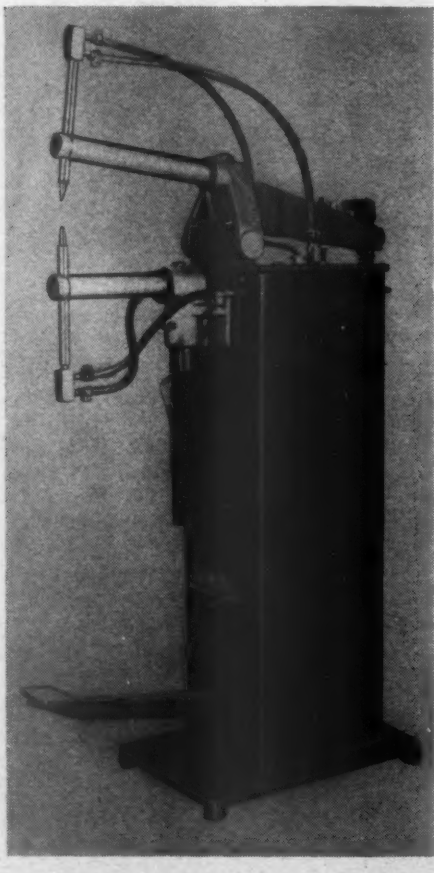
lamp has an output of approximately 200,000 beam candlepower.

The Pyle-National Company is also prepared to supply new interiors of this sealed beam type for most conventional headlights now in service. It is recommended, however, that the manufacturer's engineers be consulted on interior replacement applications due to the great variety of headlights now in use.

For switching locomotives, new lights having single sealed-beam lamps or suitable replacement interiors for most existing headlights can be supplied.

Foot-Operated Spot Welder

A foot-operated, pivot-type spot welder is available from the Agnew Electric Company, Milford, Mich., in 12-in., 18-



Floor-operated, pivot-type spot welder

in. and 24-in. throat depths. Known as the type J, the welder is equipped with a four-point tap switch with an off position for set-up purposes and with a magnetic contactor and automatic switch which passes current only after pressure is applied to the work.

The upper and lower horn mechanism is unit mounted for rigidity. Both horns are adjustable, in and out, and can be rotated. The lower horn can also be swiveled and reversed for getting into deep places. Electrical and pressure adjustments are easily accessible from the front of machine.

Construction is of fabricated steel with prelubricated bearings at wear points. The machine is furnished with the disconnect switch mounted and wired, ready for operation on connection to any single-phase ac power supply of 220, 380, 440 or 550 volts and 25, 50 or 60 cycles. The spot welder occupies a floor space of 15 in. by 18 in. plus the throat depth.

Transformer With Circuit Breaker

A line of dry-type transformers equipped with built-in primary circuit breakers and thermal protection against overloads for supplying industrial lighting and

The single case contains a dry-type transformer and primary circuit breaker with thermal trip

small-power circuits from industrial power circuits has been developed by the Westinghouse Electric Corporation. Complete in themselves, these transformers can be connected directly to open or conduit wiring, eliminating the necessity of providing junction boxes, primary switches, fuses, or circuit breakers.

The circuit-breaker handle projects through the front of the transformer case and is easily accessible. The thermal-trip elements on the circuit breaker prevent damage to the transformer from short circuits or from excessive overloads but permit nondamaging short-time overloads to be carried safely.

Ratings are available from 3 through 50 kva. for 240 to 120-240 volts, 480 to 120-240 volts, or 600 to 120-240 volts single phase, 60 cycles.

Chip Breaker Grinder

The Hammond Model C-4 chip-breaker grinder was developed to meet the need of a shop which requires some chip-breaker grinding but does not have a sufficient volume to justify more elaborate machinery. The machine will handle all types of box and single-point tools up to 2 in., and was designed particularly for carbide chip-breaker grinding.

Movement of the reciprocating table is made by means of a hand-operated lever. The tools may be set at any desired angle in the any-angle vise which has four swivels, each of which is equipped with a dial graduated in degrees. The chip-breaker wheel has vertical and cross traverse.

This product of Hammond Machinery

The Hammond Model C-4 chip breaker grinder

Builders, Inc., Dept. GP-40, 1600 Douglas avenue, Kalamazoo, Mich., has a 4-in. diameter chip-breaker wheel, a table travel of 6½ in. and a speed with either a d.c. or a 60-cycle, a.c. motor of 3,500 r.p.m.; the speed with a 50-cycle a.c. motor is 2,900 r.p.m. All dials are graduated to .001 in.

Resistance Welding Contest.—Cash prizes totaling $2,000 will be awarded by the Resistance Welding Manufacturers' Association for the best papers on design, application, or research in the matter of resistance welding entered in its 1948 contest which closes July 31. The contest is open to anyone, without restriction, from the United States, its possessions, and Canada, also to any member of the American Welding Society in any grade from any place in the World. More details concerning the contest may be obtained from the Resistance Welder Manufacturers' Association, 505 Arch street, Philadelphia 2, Pa.

NEWS

"C.B. & Q. Diesel Repairs," A Correction

In an article entitled "Chicago, Burlington & Quincy Diesel Repairs" which appeared in the March, 1948, *Railway Mechanical Engineer,* page 67, reference was made to a combination crankshaft—and axle-grinding machine installed at the West Burlington shops. This machine is manufactured by the Landis Tool Company, Waynesboro, Pa.; not by the Landis Machine Company of that address, as it was stated in the article.

Charles L. Heater Receives Steel Founders' Award

At the annual meeting of the Steel Founders' Society of America held in Chicago on February 11 the award for outstanding work in the technical and operating field of the Steel castings industry was presented to Charles L. Heater, vice-president in charge of product engineering of the American Steel Foundries. Mr. Heater has been a member of the Technical Research Committee of the Steel Founders' Society since its beginning and, for the past two years, has served as its chairman.

C. L. Heater

"Overfire Jets in Action"

Bituminous Coal Research, Inc., 912 Oliver building, Pittsburgh 22, Pa., has for distribution a new booklet, "Overfire Jets in Action," which discusses smoke abatement practice for stationary plants, railroads, and steamboats. Questions on manufacture, cost, and efficiency are also answered.

Maintaining Brake Beams And Attachments

The A.A.R. Mechanical Division reports an increasing number of brake beam failures on cars in service and that trains are arriving at terminals with brake beams down or dragging, each of these cases constituting a potential derailment. To avoid potential failures, the Mechanical Division recommends that instructions be issued to all concerned to carefully inspect and repair or replace (where necessary) brake beams and attachments—in train yards, at freight houses and when cars are on repair tracks.

I. C. C. Accident Report Renews Lightweight Controversy

The Interstate Commerce Commission has released its report on the rear-end collision which occurred on January 1 on the Missouri Pacific near Syracuse, Mo. The trains involved were passenger train No. 9, the "Missourian," westbound from St. Louis, Mo., to Kansas City, and a mail-express train operating as the second section of No. 9. The consist of the first train was a locomotive and 12 cars; in order, 3 mail cars, 1 baggage car, 1 passenger-baggage car, 2 coaches, 1 diner-lounge, and four sleepers.

Failure to operate the following train in accordance with signal indications was given as the cause of the accident. Twelve passengers and 2 Pullman employees were killed, and 32 passengers, 1 dining-car employee, 1 train porter, and 3 train-service employees were injured.

Orders and Inquiries for New Equipment Placed Since the Closing of the March Issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
Bessemer & Lake Erie	2	1,500-hp. Diesel-elec. switch.	Baldwin Loco. Works
	1	1,000-hp. Diesel-elec. switch.	Baldwin Loco. Works
Chicago, Rock Island & Pacific	24	1,500-hp. Diesel-elec. road frt.	American Loco.
	5	1,000-hp. Diesel-elec. switch.	American Loco.
	5	1,500-hp. Diesel-elec. road switch.	American Loco.
	10	4,500-hp. Diesel-elec. road. frt.	Electro-Motive
	10	1,000-hp. Diesel-elec. switch.	Electro-Motive
	5	1,500-hp. Diesel-elec. branch-line	Electro-Motive
	10	1,500-h.p. Diesel-elec. for suburban service	Electro-Motive
Louisville & Nashville	22[1]	2-8-4 steam	Lima-Hamilton
	5	1,000-hp. Diesel-elec. switch.	Electro-Motive
	5	1,500-hp. Diesel-elec. helper	Electro-Motive
	4	2,000-hp. Diesel-elec. pass.	Electro-Motive
	20	660-hp. Diesel-elec. switch.	American Loco.
	5	1,000-hp. Diesel-elec. switch.	American Loco.
Minneapolis, St. Paul & Sault Ste. Marie	4[2]	4,500-hp. Diesel-elec. frt.	Electro-Motive
	1	1,000-hp. Diesel-elec. switch.	Electro-Motive
Norfolk Southern	3	600-hp. Diesel-elec. road switch.	General Electric

Freight-Car Orders

Road	No. of cars	Type of car	Builder
Chicago, Rock Island & Pacific	1,000	P-S-1 box	Pullman-Standard
	500	70-ton hopper	American Car & Fdry.
Duluth, Missabe & Iron Range	1,000	70-ton ore	Pullman-Standard
	500	70-ton ore	General-American
Norfolk & Western	1,000[3]	70-ton hopper	Co. shops
Pacific Fruit Express Co.[4]	3,000	Refrigerator	Co. shops
Wheeling & Lake Erie	500	70-ton fixed-end gondola	American Car & Fdry.
	500	50-ton drop-end gondola	American Car & Fdry.
	500	50-ton drop-end gondola	Bethlehem Steel

Passenger-Car Orders

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	27[4]	Sleeping	Budd Co.
	29[4]	Sleeping	American Car & Fdry.
	18[4]	Baggage-express-mail	American Car & Fdry.
	24[4]	"Day-Nite" cars	Pullman-Standard
Union Pacific	50[5]	Chair	Pullman-Standard
	50[5]	Sleeping	Budd Co.

Passenger-Car Inquiries

	No. of cars	Type of car	Builder
Erie	30[6]	Baggage and express	

[1] These steam locomotives, which will cost approximately $5,900,000, are scheduled for delivery the latter part of this year. They will have a tractive effort of 79,390-lb., with booster. The L. & N. also has authorized the spending of some $600,000 for improvements in facilities needed for the operation and maintenance of the new equipment.

[2] Delivery expected to begin in June.

[3] Estimated cost of $4,250,000. Construction of these cars is expected to begin in October.

[4] The 27 sleepers will be 10 cabin-6 double bedroom cars. Of the 29 sleepers, 15 will be of the 4 compartment-4 bedroom-2 drawing room type, 13 of the 10 roomette-3 bedroom-2 compartment type and 1 of the 4 drawing room-1 bedroom-observation type.

[5] The chair cars will have aluminum structures with steel underframes. The sleeping cars will be constructed of stainless steel. Delivery is schedued for the last half of 1949.

[6] Estimated cost $1,275,000.

Notes:

The Chicago & North Western will purchase 39 Diesel-electric locomotive units of various types and 2,350 freight cars as part of its $123,500,000 maintenance and improvement program during 1948. $2,810,000 of this amount is for improvements to existing rolling stock and $32,840,000 for new equipment now on order or authorized to be placed on order. The Diesel-electric units authorized for purchase are 18 switching, 15 1,500-hp. freight and six 2,000-hp. passenger. The road will also rebuild 500 steel hopper cars at its Winona (Minn.) shops, at a cost of $1,660,000. Among other items included in the 1948 budget are the construction of a Diesel locomotive service and repair shop at Proviso, Ill., at a cost of $642,000; and the completion of its $1,860,000 modern Diesel locomotive service and repair shop at Chicago.

The fatalities occurred in the last car of the passenger train. This car is described in the I.C.C. report as being of "lightweight high-tensile steel" construction, while the other cars of the train are described as of "conventional all-steel" construction.

The force of the impact broke the brake-pipe at the front end of the first car of First 9 and caused separation between the third and fourth cars, between the fifth and sixth cars, and between the eleventh and twelfth cars. The first two separations were caused by broken couplers. The lightweight car on the rear was the only one equipped with tightlock couplers; and the separation between it and the eleventh car occurred when the rear truck of the latter was torn loose. This eleventh car, remaining coupled to the tenth car, stopped upright on the road bed. The right side of the rear vestibule was damaged.

"The twelfth (lightweight) car," as the report put it, "was telescoped at the front end a distance of about 12.5 ft. by the eleventh car and at the rear end a distance of 53 ft. 3 in. by the engine of Second 9. The engine of Second 9 sheared the rear end of the twelfth car from the underframe, sides and roof, and pushed it forward through the car, and tore out partitions and fixtures. The center sills were broken off at the rear-end bolster and were badly broken and twisted throughout practically their entire length. All cross members were torn loose from the side sills and pushed ahead of the engine." The engine and tender of Second 9 were derailed. When they stopped on the roadbed the boiler "was covered by the roof and the sides of the rear car of First 9."

The pilot of Second 9's locomotive was broken off and pushed backward from its normal position about 1.5 ft.; and the air-compressor-frame castings and the smokebox were bent. This train's first six cars and the front truck of the seventh car were also derailed, separations occurring at each end of the second to fifth cars, inclusive. The second car was "demolished." The third and fourth cars, with wooden superstructures, were described as having been "badly damaged." This was also true of the first, fifth, and sixth cars.

The report devoted considerable space to its discussion of First 9's rear car where the fatalities occurred. The car was identified as Pullman "Golden Cloud," one of a lot of 119 sleeping cars of "lightweight, low-alloy, high-tensile steel construction" built during 1941-1942. It was 84 ft. 9 in. long between the pulling faces of the couplers, contained 4 bedrooms, 6 roomettes, and 6 standard sections, and was equipped with a vestibule at one end only. Its light weight was 139,000 lb. At the time of the accident, the non-vestibule end was at the rear of the train.

"It is apparent," the report said later on, "that, when the collision occurred, the deflecting-type pilot of the engine of Second 9, because of its rounded contour and retracted coupler with coverplate, forced the rear coupler of First 9 to the left and the buffer plate to the right. This action split the draft sills and broke the entire draft and buffer assembly free from the rear body bolster. The front end of the engine sheared away all partitions, the rear body bolster, and cross framing, and pushed this debris ahead. The center sills buckled badly. The draft and buffer assembly on the front end apparently was forced downward under the rear coupler and draft assembly of the eleventh car. Damage to the eleventh car was comparatively light. Most of it resulted after the rear truck was torn loose, and the car dropped to the track after the rear two cars separated just prior to stopping."

The report then suggested that the damage to the rear car directed attention "to the capacity of lightweight cars to withstand heavy buffing stresses." It proceeded to set out A.A.R. specifications for cars used in trains of more than 600,000 lb. light weight. And it noted that these specifications had been met on test by one of the cars of the lot of 119 from which "Golden Cloud" had come. The car which was tested "withstood a squeeze-test load of 800,000 lb. without permanent deformation and with only ½ in. deflection at the center," the report said. It added that "apparently, the construction of the 'Golden Cloud' met the specifications of the A.A.R."

Alco Sponsors Railway Shop Battalion

The War Department has activated the 762nd Transportation Railway Shop Battalion (Diesel) sponsored by the American Locomotive Company. Maj. Wilbur C. Rice, maintenance and mechanical equipment supervisor at the Alco plant in Schenectady, N.Y., has been appointed commanding officer. Major Rice served with the Air Corps in the last war.

Transportation workers in railroads and industries in the Schenectady area, other than Alco, will be recruited for this battalion which will have a total of 27 officers and 282 enlisted men. Training will be for wartime servicing of railroad transport, including Diesel and steam locomotives and all rolling stock. Instruction meetings are planned once a month and no military drill or summer field training are scheduled.

Maj. W. C. Rice

The 762nd shop battalion, carries the same designation as the battalion that won distinction in World War II for its handling of the tremendous transportation difficulties of supply in Iran.

Supply Trade Notes

Purdy Company.—*John P. Purdy* has been elected president of the Purdy Company at Chicago, succeeding *S. E. Purdy*, who has become chairman of the board of directors. *John I. Duffy* has been elected executive vice-president and secretary.

◆

Greenville Steel Car Company.—*A. J. Rose* has been appointed vice-president in charge of sales of the Greenville Steel Car Company, at Greenville, Pa., to succeed *K. C. Gardner*, who has retired, but who will continue to serve in a consulting capacity.

◆

Aro Equipment Corporation.—The following changes and additions have been made in the field sales personnel of the Air Tool division of the Aro Equipment Corporation, Bryan, Ohio: *J. W. Littleton*, division manager at Cincinnati, Ohio, has been appointed manager of the Detroit, Mich., territory. *L. O. Barrett* of the Cleveland office, succeeds Mr. Little at Cincinnati. *C. Hoffman* of Indianapolis, Ind., has become a special factory sales representative. *E. A. Gransow* has been appointed assistant to E. J. Somerville, division manager at Chicago. *E. T. Fairchild* has been appointed assistant to G. M. Gille in the St. Louis, Mo., territory. *B.*

For additional information, use postcard, pages 39-40

Broekhuizen has been appointed representative in the Atlanta, Ga., territory, under J. McEwen Cherry, territory manager. *H. J. Connell* has been appointed assistant to A. B. Schuhl, manager of the New York office, and *W. Y. Smith* has been appointed to the Boston, Mass., office as assistant to T. F. O'Malley, manager in New England.

◆

BUCKEYE STEEL CASTINGS COMPANY.—*George T. Johnson, Jr.,* has been appointed sales representative in the southeastern district for the Buckeye Steel Castings Company, with headquarters at Columbus, Ohio; *Eugene B. Schrock,* sales representative in the western district, with headquarters at Chicago, and *Albert T. Johnson,* sales representative in the eastern district, with headquarters at New York.

◆

TEXAS COMPANY.—*J. M. P. McCraven* has been appointed manager of the railway traffic and sales department of the Texas Company, with headquarters at New York, succeeding J. L. Lavellee, deceased. Mr. McCraven became associated with the Texas Company at Houston, Tex., in 1916 and has served, successively, as chief accountant, assistant district manager, district manager, and assistant manager at Chicago.

◆

BRIDGEPORT SAFETY EMERY WHEEL COMPANY.—*Henry F. Kalweit* has been appointed president and a member of the board of directors of the Bridgeport Safety Emery Wheel Company, succeeding John T. Kilbride, resigned. *William G. Schultz* has been appointed vice-president in charge of sales and the machinery division, and *Frank B. Laurich,* vice-president in charge of the wheel division.

◆

LINCOLN ELECTRIC COMPANY.—*H. E. Cable,* formerly general manager of Aluminate Chemicals Ltd., Toronto, Ont., has been appointed district manager of the Pittsburgh, Pa., office of the Lincoln Electric Company, to succeed *J. S. Roscoe,* who has been transferred to the Chicago office as district manager.

◆

AMERICAN CAR & FOUNDRY CO.—The Berwick plant of the American Car & Foundry Co. has been awarded the company's Safety Trophy for 1947. With an average of 3,546 employees throughout the year, the accident rate at Berwick for 1947 was only 9.67 accidents per million man-hours worked.

◆

FAFNIR BEARING COMPANY.—*Maurice Stanley,* president of the Fafnir Bearing Company for the last 21 years, has been elected chairman of the board. *Stanley M. Cooper,* formerly executive vice-president, succeeds Mr. Stanley as president.

◆

FRANKLIN RAILWAY SUPPLY COMPANY.—Overfire air jets with mufflers, developed by *Bituminous Coal Research,*

 For additional information, use postcard, pages 39-40

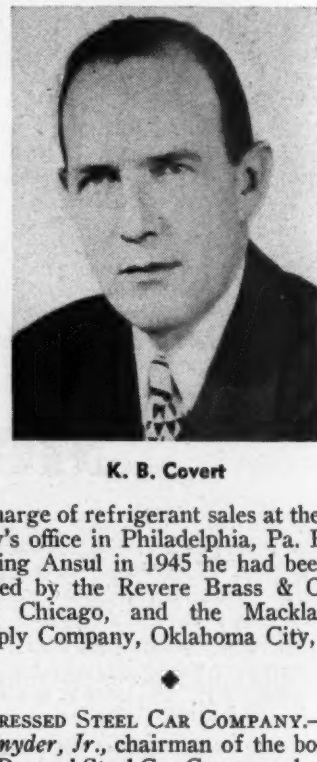
Inc., as a result of several years' research, are now being manufactured and sold by the Franklin Railway Supply Company. B. C. R. is continuing its research in smoke abatement methods and as refinements in the jets and their controls are made they will be incorporated in the Franklin product.

◆

PHILADELPHIA STEEL & WIRE CORP.—*Frank J. Meyer,* chief engineer of the railway products division of the Philadelphia Steel & Wire Corp., has added to his present duties those of agent for all sales activities in the Chicago and Twin Cities area, with headquarters in Chicago.

◆

ANSUL CHEMICAL COMPANY.—*Kenneth B. Covert* has been appointed sales manager of the fire extinguisher division of the Ansul Chemical Company, Marinette, Wis. Mr. Covert was previously



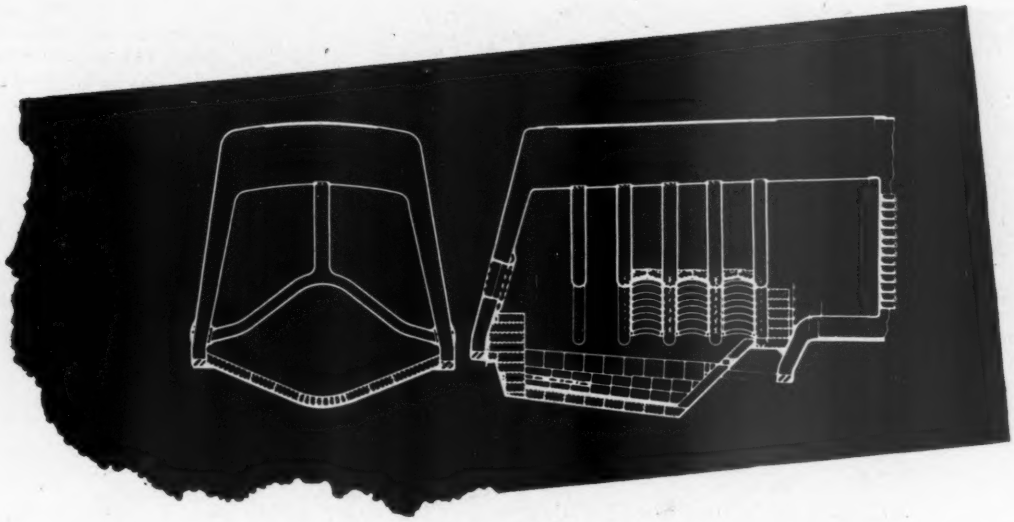
K. B. Covert

in charge of refrigerant sales at the company's office in Philadelphia, Pa. Before joining Ansul in 1945 he had been employed by the Revere Brass & Copper Co., Chicago, and the Macklanburg Supply Company, Oklahoma City, Okla.

◆

PRESSED STEEL CAR COMPANY.—*John I. Snyder, Jr.,* chairman of the board of the Pressed Steel Car Company, has been elected president, to succeed Ernest Murphy, who has retired. Mr. Snyder, a sketch of whose career appeared in the January issue, will continue as chairman of the board of directors. *William T. Kilborn,* president of the Flannery Bolt Company, has been elected a director and chairman of the executive committee of Pressed Steel.

Ernest Murphy was born in Padiham, England. He came to the United States in 1909 and became division engineer in charge of construction of the Butler, Pittsburgh, Harmony & New Castle Interurban Traction Company. In 1911 he became associated with the Interborough Rapid Transit Company and in 1917 with the United Traction Company at Albany, N.Y. From 1917 until 1940 he was also president of the Capital District Transportation Company in Al-



Security Circulators being installed in 2-8-2 oil-burning locomotives

In modernizing a group of 2-8-2 oil-burning steam locomotives, each is being equipped with five Security Circulators, according to the arrangement shown in the sketch.

The installation of Security Circulators in a locomotive boiler provides additional heating area in the path of the hot gases. This enables the locomotive to get up steam more quickly, increases the water circulation from the side water-legs over the crown sheet, and aids in maintaining maximum boiler output.

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

For additional information, use postcard, pages 39-40

bany. Mr. Murphy joined Pressed Steel in 1941 at the Hegewisch plant, Chicago, where he was in charge of the Armored Tank division. He later became vice-president in charge of operations and was elected president in 1945.

◆

American Brake Shoe Company.—*Fred P. Biggs* has been appointed first vice-president of the Brake Shoe and

F. B. Biggs

Castings division of the American Brake Shoe Company. Mr. Biggs will continue also as vice-president in charge of the Brake Shoe and Castings and Southern Wheel divisions. *Roger W.*

R. W. Batchelder

Batchelder, formerly general purchasing agent, has been appointed assistant to the president of the National Bearing division, with headquarters in St. Louis, Mo.

◆

Tyson Bearing Corporation.—*George C. McMullen* has been appointed vice-president in charge of sales of the Tyson Bearing Corporation, Massilon, Ohio. *W. H. Oexle,* formerly southeastern district manager of the L. S. Starrett Company, has been appointed general sales manager of Tyson. *Herschel J. Deal* has been appointed vice-president in charge of the midwest territory, with headquarters in Chicago. *Ivan C. Mann,* manager of replacement sales, is now as-

Keeping up a fast pace

On the Cotton Belt Route five General Motors freight locomotives have averaged more than 48,000 gross-ton miles per month since entering service—establishing a new tempo of dependable, revenue-producing, cost-cutting operation.

Three of these locomotives were delivered in June and July 1944; the other two in June 1945. Through October of last year they had amassed a total of 2,113,020 miles — an average per locomotive of 11,938 miles per month — with over-all availability against potential hours in the period of 83.0%. An excellent performance when you consider the freight volume handled.

In Diesels as in other things, proved performance counts. Here it also signifies the quality and durability built with General Motors Diesels — the one and only product built by Electro-Motive in the largest and most modern plant of its kind.

GENERAL MOTORS LOCOMOTIVES

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS LA GRANGE, ILL.

sistant sales manager. *R. R. Flaisig*, field service representative, has been appointed representative in the southern Ohio territory. *E. M. Smith*, chief inspector at the Massilon plant, is now in charge of the northeastern territory, with headquarters in Philadelphia, Pa. *Carl M. Behm*, formerly sales representative for Bearing Distributors, Inc., has been appointed a representative for Tyson in Northern Ohio.

◆

BAKER - RAULANG COMPANY. — The *Hooper-Green Company*, 1039 Pennsylvania street, Indianapolis, Ind., has been appointed district sales representative in the Indiana territory for the Baker-Industrial Truck division of the Baker-Raulang Company.

◆

AMERICAN WIRE & STEEL CO.—*H. H. Bullen*, sales representative of the American Steel & Wire Co., has been appointed manager of western district electrical products sales, covering 14 states, with headquarters as before at Chicago.

◆

NATIONAL MALLEABLE & STEEL CASTINGS CO.—*Kenneth L. Selby*, formerly engineering assistant of the National Malleable & Steel Castings Co., has been appointed chief engineer of the railway

Kenneth L. Selby

division to succeed the late *Howard W. Gilbert*.

Before joining National in 1945, Mr. Selby worked for the Pullman Company, the Illinois Central and the Alton. He is a member of the American Society of Mechanical Engineers and the Cleveland Engineering Society.

◆

LANDIS TOOL COMPANY.—*B. L. Sylar & Son*, 105 Belvoir avenue, Chattanooga, Tenn., has been appointed sales distributor in Tennessee for the Landis Tool Company's line of precision cylindrical grinding machines.

◆

LUKENS STEEL COMPANY.—The Lukens Steel Company and Divisions (By-Products Steel Company and Lukenweld), Coatesville, Pa., have announced the appointment of *Andrew J. Lacock* as

Railway Executives:

take a new look at car floor maintenance costs

You will find it worth your while to break down car maintenance costs and determine how much you spend for floor repairs and replacement. It will probably run to a big figure. Damage to conventional floors from rough freight, nailing, decay, and materials-handling equipment is taking place every day, on every road.

now something can be done about it

The answer:

*NAILABLE STEEL FLOORING

Bloom Croppings—Magnet Loaded—This kind of freight dishes conventional steel-plate floors out of shape, and shouldn't be loaded at all in wood floor cars. NAILABLE STEEL FLOORING stays generally flat and nailable under impact loading.

You can now take a big cut out of floor repairs—and *virtually eliminate floor replacements*—by standardizing on NAILABLE STEEL FLOORING in box cars, flats and gondolas. This tougher, all-purpose flooring is built to last as long as the car, and here's why:

High Structural Strength—NAILABLE STEEL FLOORING in boxcars will not fail under fork trucks; in gondolas, there are no break-throughs from impact loading.

No Damage From Nailing—Nails really hold in NAILABLE STEEL FLOORING (tighter than in wood) yet they don't damage the floor in any way.

High Wear-Resistance—Abrasive wear from rough freight and loading equipment that destroys wood floors is negligible in NAILABLE STEEL FLOORING.

No Torn Up Plates—With no rivet heads or plate edges, NAILABLE STEEL FLOORING can't be ripped up during clamshell unloading of bulk freight.

Fork Trucks—Efficient loading demands them, but they're tough on wood floors. NAILABLE STEEL FLOORING safely takes the heaviest boxcar loading equipment.

*PATENTS PENDING

Break down your car maintenance costs—and find out *how much* NAILABLE STEEL FLOORING can save in floor repair and replacement costs.

NAILABLE STEEL FLOORING
A GREAT LAKES STEEL PRODUCT

GREAT LAKES STEEL CORPORATION
STEEL FLOOR DIVISION, PENOBSCOT BLDG., DETROIT 26, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

For additional information, use postcard, pages 39-40

district manager of sales, New York district sales office, 50 Church street, New York 7. *J. J. Reynolds,* who has been district manager of sales in New York, will continue to serve as a member of the staff in the New York district sales office.

◆

Hennessy Lubricator Co.—The office of the Hennessey Lubricator Company has been removed from 75 West street, New York, to Chambersburg, Pa.

◆

Symington - Gould Corporation.—*Arthur E. Heffelfinger,* sales engineer of the Symington-Gould Corporation since 1924, retired on January 1.

Mr. Heffelfinger was born in Reading, Pa., on April 10, 1881, and began his business career in 1900 as a special apprentice in the car department of the Philadelphia & Reading (now the Reading). From 1903 to 1905 he was a car draftsman for, successively, the former Harlan & Hollingsworth Corp. and the Pressed Steel Car Company. During the next eight years he was associated with the American Car & Foundry Co. in various capacities, finally as a sales engineer in Cuba. He became sales engineer of the Richardson Scale Company in 1913 and in 1914 joined the Universal Car & Manufacturing Co. as a mechanical engineer. One year later he went to Hamilton, Ont., as chief engineer for the National Steel Car Company. He joined the T. H. Symington Company, a predecessor of the Symington-Gould Corporation, in 1919 as a mechanical engineer.

A. E. Heffelfinger

◆

American Steel Foundries.—*Carl E. Tack* has been appointed assistant chief mechanical engineer of the Product Engineering department of the American Steel Foundries at Chicago. Mr. Tack has been associated with the company since 1937, principally as mechanical engineer in charge of product development.

◆

Allis - Chalmers Manufacturing Company.—*E. H. Horstman,* formerly assistant chief engineer of the steam-turbine department of the Allis-Chalmers

For additional information, use postcard, pages 39-40

Manufacturing Company, has been appointed chief engineer. *Hans P. Dahlstrand,* formerly consulting engineer of that department has been appointed director of engineering.

◆

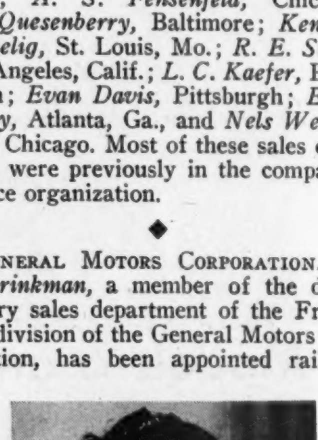
Pipe & Tubular Products, Inc.—*T. H. Bateman,* who was formerly associated with W. H. S. Bateman & Co. for over 15 years, has joined the sales department of Pipe & Tubular Products, Inc., and will assume charge of railroad sales, in addition to being a special representative in the industrial field.

◆

Black & Decker Manufacturing Co.—The former sub-branch of the Black & Decker Manufacturing Co. at Charlotte, N.C., has been established as headquarters for a new territory comprising the states of North Carolina and South Carolina. *G. M. Buchanan,* former branch manager at Baltimore, Md., has been placed in charge at Charlotte. *J. P. Spain,* former sales engineer at Chicago, has been appointed branch manager in charge of the Baltimore branch. *Arthur S. Boehm,* former sales engineer at Pittsburgh, Pa., has been appointed branch manager in charge of the San Francisco, Calif., branch, succeeding *A. W. Helbush,* resigned. The following have been appointed sales engineers: *David Harrison,* Baltimore; *Harold Bond,* New York; *A. S. Fehsenfeld,* Chicago; *Coy Quesenberry,* Baltimore; *Kenneth Schmelig,* St. Louis, Mo.; *R. E. Stone,* Los Angeles, Calif.; *L. C. Kaefer,* Pittsburgh; *Evan Davis,* Pittsburgh; *E. O. Gulley,* Atlanta, Ga., and *Nels Westerberg,* Chicago. Most of these sales engineers were previously in the company's service organization.

◆

General Motors Corporation.—*R. C. Brinkman,* a member of the direct factory sales department of the Frigidaire division of the General Motors Corporation, has been appointed railroad sales representative. Mr. Brinkman has been associated with Frigidaire for 19 years. He was in the sales order and foreign departments before being transferred to the direct factory sales department in 1945.



R. C. Brinkman

BALDWIN LOCOMOTIVE WORKS.—*R. Nevin Watt,* formerly general sales manager of the Baldwin Locomotive Works, has been elected assistant vice-president, domestic sales, and *Raymond B. Crean,* formerly assistant to the vice-president, operations, has been elected assistant vice-president, production. *Roland C. Disney,* formerly assistant general sales manager, has been appointed manager of domestic sales. *Robert G. Tabors,* formerly sales manager for the William H. Harman Corporation, has been appointed sales manager of the hydraulic press and power tools section of the Eddystone, Pa., works. *Eugene S. Wright,* formerly sales manager of Diesel products at Eddystone, Pa., has been appointed district sales manager, at St. Louis, Mo.

R. Nevin Watt joined the Standard Steel Works Company, now a division

R. N. Watt

of Baldwin, in 1913. He was appointed sales manager of Standard Steel in 1930 and general sales manager of Baldwin in 1942.

Raymond B. Crean was formerly comptroller and manager of the statistical department of the National Electrical Manufacturers Association. In

R. B. Crean

1943 he joined Baldwin as assistant to the comptroller and later was appointed assistant to the vice-president, operations.

Roland C. Disney worked in the engineering department of the Western Elec-

tric Company for eleven years until 1941 when he entered the United States Army. After his release he joined Baldwin in February, 1946, as eastern district

R. C. Disney

sales manager and, in June, 1947, was appointed assistant general manager of sales.

Robert G. Tabors was associated with Baldwin from 1937 until he entered the United States Army during the recent war. After the war he joined the William H. Harman Corporation as sales manager.

◆

WATSON-STANDARD COMPANY.—*John J. Hart, Jr.,* formerly assistant manager of the Feller engineering division of the Lake Erie Engineering Corporation, has been appointed sales manager of a recently formed division of the Watson-Standard Company, Pittsburgh, Pa.

◆

EASTERN STAINLESS STEEL CORPORATION. — *Robert F. Johnston,* formerly sales service engineer for the Eastern Stainless Steel Corporation, Baltimore, Md., has been appointed assistant general sales manager.

◆

Obituary

HOWARD W. GILBERT, engineering assistant to the president of the National Malleable & Steel Castings Co., at Cleveland, Ohio, died recently.

◆

LOUIS G. VOCK, district sales manager of the Metal & Thermit Corporation's welding division, with headquarters at Chicago, died in the Wesley Memorial hospital in that city on January 26, after a prolonged illness.

◆

JAMES L. LAVALLE, manager of the railway traffic and sales department of the Texas Company, New York, died on February 12. Mr. Lavalle was born in Boerne, Texas, in 1884. He began his railroad career as an apprentice machinist, and later worked as master mechanic on the National Railways of Mexico. He subsequently joined the Gulf Coast Lines and became successively master mechanic, assistant superintendent, and

 For additional information, use postcard, pages 39-40

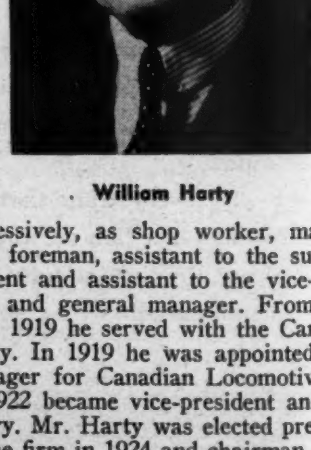
superintendent of motive power. In November, 1922, he joined the Texas Company as a lubrication engineer. He was appointed assistant manager of rail-

James L. Lavalle

way sales at Chicago in July, 1928; sales manager at New York in October, 1937, and manager of railway traffic and sales department in July, 1939.

◆

WILLIAM HARTY, executive vice-president of the Canadian Car & Foundry Co., died on February 12. Mr. Harty was born in Kingston, Ont., Canada, on September 18, 1878. He was educated at the Kingston Collegiate Institute and the Royal Military College in Kingston. After graduation from the latter in 1900 he worked for two years in the shops of the Pittsburgh Locomotive Company. From 1902 until 1904 he did post-graduate work on locomotives at Purdue University. Mr. Harty joined Canadian Locomotive in 1904, serving,

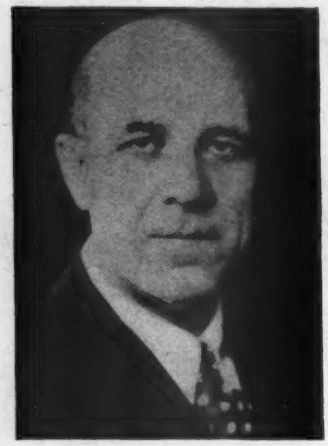


William Harty

successively, as shop worker, machine shop foreman, assistant to the superintendent and assistant to the vice-president and general manager. From 1914 until 1919 he served with the Canadian Army. In 1919 he was appointed sales manager for Canadian Locomotive and in 1922 became vice-president and secretary. Mr. Harty was elected president of the firm in 1924 and chairman of the board in 1932. In the latter year he also became vice-president of Canadian Car & Foundry.

For additional information, use postcard, pages 39-40

Tracy V. Buckwalter, who retired in 1945 as chief engineer and vice-president of the Timken Roller Bearing Company, died at Fort Lauderdale, Fla., on March 15. Mr. Buckwalter was 67. He became associated with the Timken Company in 1916 as chief engineer after 16 years in the Altoona, Pa., shops of the Pennsylvania. He was elected vice-president of Timken in 1925. Under his direction that company was responsible in large measure for the development and widespread installation of roller bearings on locomotives, and passenger and freight cars.



T. V. Buckwalter

Personal Mention

General

J. E. Carter has been appointed motive-power inspector of the Chesapeake & Ohio at Clifton Forge, Va.

H. H. Urbach, mechanical assistant to the vice-president of the Burlington lines, with headquarters at Chicago, has been appointed general superintendent of motive power and machinery, with headquarters at Chicago.

Frank J. Jumper, whose retirement as general mechanical engineer of the Union Pacific at Omaha, Neb., was reported in the February issue, was born at Terre Haute, Ind., on August 1, 1877. He received his bachelor of science degree in electrical engineering at Rose Polytechnic Institute at Terre Haute. In 1905 he became assistant mechanical engineer of the Union Pacific, and in 1909 mechanical engineer of the McKeen Motor Car Company in Omaha. He returned to the Union Pacific in 1920 as general manager of the motor-car department and during the subsequent years was chief draftsman, special engineer of inspection, engineer of inspection, assistant general mechanical engineer, and acting general mechanical engineer. In December, 1937, he was appointed general mechanical engineer.

Diesel

T. V. Methe has been appointed Diesel instructor of the New York Central, with headquarters at New York.

H. C. Paige, assistant mechanical engineer of the New York, New Haven & Hartford at New Haven, Conn., has been appointed superintendent Diesel locomotive maintenance.

W. H. Chaplin has been appointed assistant general Diesel foreman of the Boston & Maine at Boston, Mass.

G. P. Silva has been appointed general Diesel foreman of the Boston & Maine at Boston, Mass.

Master Mechanics and Road Foremen

J. W. A. Goulet has been appointed road foreman of engines, Cochrane division, of the Canadian National, with headquarters at Parent, Que.

R. J. Parsons has been appointed assistant master mechanic of the New York Central, with headquarters at Harmon, N.Y.

Archie G. Waldrupe has been appointed master mechanic of the Southern with headquarters at Macon, Ga. Mr. Waldrupe was previously master mechanic at Bristol, Va.-Tenn.

C. E. A. Gelly has been appointed road foreman of engines of the Canadian National, with jurisdiction over the Laurentian Division, and headquarters at Chauvigny, Que.

W. D. Shults, general foreman, Pegram shop, of the Southern at Atlanta, Ga., has been appointed assistant master mechanic, with headquarters at Atlanta.

Floyd E. Kimball, assistant master mechanic of the Southern at Atlanta, Ga., has been appointed master mechanic, with headquarters at Bristol, Va.-Tenn.

Electrical

E. E. Ball, superintendent electric and Diesel locomotive maintenance of the New York, New Haven & Hartford at New Haven, Conn., has been appointed superintendent electric locomotive maintenance.

Car Department

A. W. Oldfield, car foreman, Central Station, of the Canadian National at Montreal, Que., has retired.

Odell T. Kesler has been appointed foreman car repairs of the Southern at Winston-Salem, N.C.

William E. Haynes has been appointed foreman boiler shop of the Southern at Princeton, Ind.

R. J. Payne, car foreman of the Canadian National at Longue Pointe, Que., has been appointed car foreman, Central Station, Montreal, Que.

B. Griffin has been appointed foreman coach shop, Hayne car shop, of the Southern at Spartanburg, S.C.

C. M. Stephen has been appointed car foreman, repair track, of the Canadian National with headquarters at Longue Pointe, Que.

Boiler Shop

Frank White, boilermaker foreman of the Norfolk & Western at Williamson, W. Va., has been transferred to the position of boilermaker foreman, Shaffers Crossing Shop, Roanoke, Va.

M. R. Francis, assistant boilermaker foreman of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of boilermaker foreman at Williamson, W. Va.

J. L. Turner, gang leader of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of assistant boilermaker foreman at Portsmouth.

G. J. Lucas, boilermaker foreman, Shaffers Crossing shop of the Norfolk & Western at Roanoke, Va., has been transferred to the boiler shop, Roanoke shops, as assistant foreman.

Shop and Enginehouse

Vernon R. Coward has been appointed assistant foreman enginehouse (day) of the Southern at Monroe, Va.

Samuel R. Bruce has been appointed general foreman enginehouse (night) of the Southern at Spencer, N.C.

John M. Oliver has been appointed foreman erecting shop of the Southern at Birmingham, Ala.

William E. Mills has been appointed assistant foreman enginehouse (night) of the Southern at Monroe, Va.

James R. Cress has been appointed foreman enginehouse (night) of the Southern at Monroe, Va.

Marion W. Glenn, general foreman of the Southern at Anniston, Ala., has been transferred to the position of general foreman at Princeton, Ind.

Herbert P. Newman has been appointed foreman machine shop of the Southern at Spencer, N.C.

Albert N. Oden, erecting shop foreman of the Southern at Birmingham, Ala., has been promoted to the position of general foreman at Anniston, Ala.